NATURE

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Physical Fitness at Universities

THOSE Englishmen—unfortunately still very few—who are acquainted with the universities of Canada and the United States, have long had cause for astonishment, indeed for shame, at the way in which the universities of Great Britain have lagged behind those of America in their care for the health and fitness of their students. In those countries at any rate, it cannot be suggested that the desire to produce a healthy population is a sign of latent militarism or of any peculiar brand of politics. To an American or Canadian student—or professor—visiting Great Britain, it seems incredible that in most of our universities there is no medical examination whatever, either at entry or later on, no organized system (voluntary or compulsory) of physical exercise, little provision (except in a few privileged places) for healthy recreation 'in the spare half-hour', no arrangement to provide medical or surgical advice or treatment when required.

A wider knowledge of our deficiencies in this respect, and perhaps a stimulus to make them good, is given by a very timely pamphlet, "Student Health", recently issued by the National Union of Students.* In this pamphlet the need of student health services and of greater facilities for healthy exercise and recreation is discussed, the services and facilities existing in the United States, in Canada, in Germany and in Sweden are described, an account of what is already being done, or is contemplated, in the universities of Great Britain is set out, and a 'minimum policy' for the future is proposed.

The causes of this neglect are various and to some degree, at least, a matter for speculation: the medieval view, based upon a false antithesis of mind and body, that the universities exist solely for the training of the intellect; a superstitious horror of anything which might savour of organization, discipline or compulsion in personal affairs; a belief in the magic of *laissez-faire*; the dominant position in public life of Oxford and Cambridge, where the colleges exert a parental influence, where most of the students are not so poor, and where games and recreations are much easier to get; indifference; and a fear that students themselves might not co-operate. The last cause at least is removed by the publication of this pamphlet on behalf of the students themselves. It is peculiarly timely because, unknown to its writers, a new movement was already under way and that movement will be given greater confidence and strength by the knowledge that the National Union of Students is openly and emphatically sympathetic. The committee of the Union which discussed the matter "was struck with the fantastic lack of attention there had been in this country to scientific methods of physical education". "It became more and more impressed with the importance of preventive as well as curative methods". The systems in other countries, it found, "indicate a very general acceptance by the universities of a great measure of responsibility for the physical as well as the intellectual well-being of their students, a responsibility which is still to a large extent shirked by the universities of Great Britain".

In the autumn of 1937, the National Fitness Councils for England and Wales and for Scotland invited the University Grants Committee to advise on the distribution of a capital sum of £230,000 to aid the universities of Great Britain in providing urgently needed facilities for healthy recreation and for physical exercise. The sum itself is small—

* Student Health: the Report of an Enquiry into University Health Services by the National Union of Students. Pp. 104. (London: National Union of Students, 1938.)

only about one tenth of the annual Treasury grant, for all purposes, to the universities—and it can do no more (it was not intended to do more) than catalyse the interest of the universities themselves and perhaps of their potential benefactors. That, however, it is beginning to do, and although the £230,000 itself cannot be spent otherwise than on facilities for healthy recreation—on gymnasia, swimming baths, squash courts and the like—it has set the universities thinking and planning, and ultimately very much more may result. In most of them—indeed if not all—voluntary medical examinations are to be instituted, lectures will doubtless be given on matters relating to health, the status of members of the staff dealing with physical training is to be raised, the co-operation of scientific and medical departments is to be sought, committees are to be formed to consider the place of student health as a proper function of a university; and probably, under the guidance of the Medical Research Council, in certain special centres, a scientific examination of the problem is to be instituted. An attempt is to be made, in fact, to give to the subject of bodily and mental health and fitness its proper university status. Those, however, who take a longer view will realize that it is not merely 'student health' as such which is to be aimed at, but—through the universities—the intelligent and conscious application of a new biological outlook on human beings, an outlook intended ultimately to affect the entire community.

Health is a positive thing, namely, living up to the best powers of the individual. It is not merely absence of obvious diagnosable disease. As a matter of fact, however, even among students, disease is common enough. A professor in a medical school writes:

"Recently there have come within my notice four students with mild or severe mental trouble, three cases of early tuberculosis, and a host of minor ailments, such as trouble with hearing, vision and teeth, tonsils, colds, influenza, muscular pains, skin diseases, lassitude, anæmia, and not so very infrequently fears about health."

What is true of medical students is just as true—though not perhaps so easily realized—of others. To recognize disease, or minor ailments, or chronic under-nutrition, or mental trouble, or anything lowering the level of happiness, fitness and usefulness in university students, and to provide means of improvement, are important enough. Even more important, however, in the long run, is to send out steadily into the community a stream of intelligent and keen young people who have learned, even in a minor way, what a health service can do for them and their friends, and how necessary it is to the happiness and well-being of the people.

Medicine at present consists too largely of the diagnosis and treatment of obvious disease, often when it is too late for complete health ever to be restored. Hospitals are crowded and only urgent cases can be considered. Human biology must take a much wider view than this of its duties and opportunities. Adequate nutrition, in quantity and quality, exercise suited to the needs and powers of the individual, healthy recreation, a sane outlook on bodily functions—not disregarding sex and reproduction—guidance and help in mental and emotional difficulty, the profitable use of holidays and leisure, all these require an educated public opinion. How better may that educated opinion be built up than by giving to those who pass through the universities some personal appreciation and understanding of the part which an adequate health service, taking account of all such factors and employing all the resources of science, can play in promoting the well-being of those whom it reaches?

Protection of Ancient Monuments in Britain*

THE recently issued list of monuments in England, Wales and Scotland now protected under the Ancient Monuments Acts contains the names of more than five thousand monuments. These are of all kinds from prehistoric camps, stone circles, and barrows to the remains of abbeys, castles, bridges and even relatively modern buildings. Three hundred and twenty-five monuments were added to the list in 1937. Especially noteworthy among the additions are Bewcastle Roman fort, St. Alban's Gatehouse, with its archway and turrets, Reigate old town hall, which it had been proposed to demolish, the remains of the palace of Archbishop Roger at York, dating from the

* Ancient Monuments of Great Britain: List of Monuments to December 31, 1937, prepared by the Commissioners of Works. Pp. 101. (London: H.M. Stationery Office, 1938.) 1s. 6d. net.

twelfth century, and the remains of the monastic settlement on Faroe Island.

Although the list is known not to be exhaustive, as is pointed out by Sir Patrick Duff in his introductory note, it serves to indicate the wealth of Great Britain in remains of historic and æsthetic interest, as well as the multifarious activities of the Ancient Monuments Branch of the Office of Works. Between 1921 and 1931 the Commissioners published lists which indicated from time to time the monuments to which State protection had been granted under the Act of 1913; but since 1931, when the new Act was passed, the list, which it is incumbent on the Commissioners to publish under the law, has been made more comprehensive by the inclusion of those monuments appearing in previous lists, as well as certain classes of monuments for which the Commissioners are responsible in various ways by deed of gift, guardianship, or purchase, or as Crown property, or as situated on Crown property, though not under custody. There also appear the buildings of historic or architectural interest, some wholly or partially in occupation, for the maintenance of which the Office of Works is responsible. Among those in this last category are the Banqueting Hall, Whitehall, the Jewel Tower, Westminster, Holyroodhouse, Edinburgh, Glasgow Cathedral and Dunblane Cathedral.

The interest of the list to the general public, and even its value to the expert, might be considerably enhanced by some such additions as a brief statistical statement in the nature of a progress report, an indication of the latest inclusions, and the date of protection of each monument. Although the introductory note records recognition by the Commissioners of the assistance of local archæologists in compiling the lists, archæologists on their side would acknowledge that the organization and personnel of the Ancient Monuments branch of the Office of Works, as at present constituted, provide a combination of scientific knowledge and practical training and experience best calculated to secure the co-operation of Government department and public, represented by the local expert, which it is the aim of successful administration in a democratic community to secure.

The departmental inertia in matters affecting our antiquities, which caused General Pitt-Rivers to refuse for many years to draw his salary as inspector of ancient monuments, has long been a thing of the past; and Sir Frederic Kenyon in his presidential address to the Society of Antiquaries on April 28 was fully justified in referring to the work of the Commissioners through the ancient monuments inspectorate as the most striking advance in the official recognition of archæology in our time. When, however, Sir Patrick Duff says that "the present enlarged list cannot be regarded as covering in a systematic way the whole of the more important Ancient Monuments of Great Britain", and Sir Charles Peers can tell the Oxford Branch of the Council for the Preservation of Rural England, at the meeting at Oxford on April 30, that the work already done in the protection of ancient monuments is no more than a beginning, it is evident that no means should be neglected to enlist the interest of the public, if the State, as many would like to see, is to take a greater and more responsible share in the systematic advancement of archæological knowledge. The more widely it is known how much is already accomplished by the Office of Works in the course of the year, the more readily will it be possible to win public support for an extension of its activities.

Ideals and Conflicts of Civilization

Ends and Means:

an Enquiry into the Nature of Ideals and into the Methods employed for their Realization. By Aldous Huxley. Pp. v + 336. (London: Chatto and Windus, 1938.) 8*s*. 6*d*. net.

SIX years ago Mr. Huxley presented to the world the picture of a "Brave New World". The days of that scientific Utopia, so cleverly constructed with satire and malice out of Mr. Huxley's rich imagination, are gone. The brave new world is changed to the Utopia of an evangelist, a Utopia seen through the haze of an infinitely troubled world. "Ends and Means" deals with the critical state of present world conditions and with the ideal individual. It considers the problems of domestic and international politics, of education, of religion and ethics, and in it Mr. Huxley tries to suggest a way out of the conflicts which now threaten the destruction of civilization.

Mr. Huxley has applied himself to his task with a faith that cannot fail to command respect, and

with a certainty which belongs far more to the mystical world of religious reformers than to the world of reality in which the book was written. The gloomy picture which he paints of the state of the world is also so familiar that at first one fails to realize that it is charged with a brilliant analysis of the conditions that have led to it, and with an equally brilliant statement of the only possible outcome if existing social trends remain as they are. But Mr. Huxley differs from most other social reformers in what he thinks necessary to transform our present social environment into a better one. He does not share the common belief that the way to alter the structure of society is through large-scale political and economic reforms. On the contrary, he holds that transformation brought about by such means would not be accompanied by that necessary change of heart, by that free renunciation of personal ambitions which in his opinion alone can transform human society into an association of peoples in which the first consideration is the common good. National planning he finds inconsistent with international peace, and he argues convincingly that the defence of democracy against fascism inevitably entails the transformation of democracy into fascism. After considering many possible principles of social change, he concludes that the only certain political road to social security is non-violence and decentralization. To achieve these ends he asks that all people should become "non-attached"—non-attached to power, to possessions, to bodily sensations, to fame, non-attached even to science, art and philanthropy. It is plain that to enter Mr. Huxley's kingdom of man, man must completely stop being the mammal we know him to be. Unfortunately, the educational policies, and the mental and physical exercises which he suggests will bring about this transformation, are scarcely practical enough for our immediate needs.

In the few months that have passed since Mr. Huxley's book appeared, society has become even more insecure than it was when the book was written. Mr. Huxley's views have correspondingly receded further from any realm of practical politics. Retreat to mysticism is a poor prescription for the millions who already, through the turn of political fortune, have to face violent death. To suggest that ruthless dictatorships can be opposed by masses determined not to use violence seems equally unreal—for in the absence of opposition there seems no reason why ruthlessness should not continue for ever. Mr. Huxley's argument almost leads to the conclusion which he is anxious to avoid, to the view that violent dictatorships can only be opposed by violence. But irrespective of any such considerations, one has to remember that most of those who make up the world's population are completely unaware of their "attachments", and especially of those particular attachments the interplay of which, in the form of national politics, are most responsible for the present critical condition of society. Politics, it may be true, becomes more and more a game whose counters are *a priori* concepts that are devoid of meaning, counters whose moves completely obscure the simple wishes of simple people. It is, however, no use supposing that one set of *a priori* concepts are any more valid than any other. To use "spiritual exercises" to get "spiritual insight" into "ultimate reality", to form "a mystical union of the soul with the integrating principle of all being", concepts which Mr. Huxley advances, means no more to the vast majority, perhaps even less, than to use "national honour" to defend the "vital interests" of "society", concepts which Mr. Huxley may rightly regard as empty of real meaning and as propaganda to further the exploitation of the many for the benefit of the few. One cannot help wishing that Mr. Huxley, in discussing the vital issues which make up his book, had himself abided by his desire for terms of "concrete contemporary reality".

The most vital of all these issues is the fact that now, almost more than at any other time in human history, there is a premium on human aggressive tendencies, and the most vital of all the problems considered by Mr. Huxley is that of finding means for restraining these tendencies. Mr. Huxley admits that reforms can transfer the undesirable tendencies of individuals from one channel to another channel, but because transference does not abolish what he regards as a fundamental evil, he detracts somewhat from the value of reforms which bring it about. So fundamental an evil as aggressiveness, which observations suggest is a biological heritage, can scarcely be dissipated at its source in the way Mr. Huxley suggests, and it is plain that our only immediate hope of securing the future is to divert, through scientific planning, expressions of dominance from more undesirable to less undesirable fields of social activity. Science cannot be treated, as Mr. Huxley often treats it, as though it were some human epiphenomenon. "Technological progress," he writes, "has reduced the number of physical contacts, impoverished the spiritual relations between members of a community." Whatever these particular relations may be, it is even more true that science has also immeasurably enriched other and more immediate relations between human beings. Technological progress may have provided us "with more efficient means of going backwards". It has no less provided us with more efficient means of progressing. If the civilization of to-day fails to take advantage of these possibilities, it will not be because of the

introduction of scientific method into social affairs —for it is certain that success will be achieved only when that which is rational becomes enthroned. Mr. Huxley's present mysticism will not clear the darkness which at present prevents the application of reason in social affairs.

In spite of the shortcomings of the plans it advocates, Mr. Huxley's book is a magnificent achievement, and it is impossible not to be deeply impressed by the wide sweep of his imagination and knowledge. His method of saving the world may not be effective. He has, however, more than helped to outline the problems by which we are faced, and in doing so he has written a book which, in carving its own territory, has cut across all accepted lines of politics and belief.

Climatology of the British Isles

The Climate of the British Isles: being an Introductory Study of the Official Records, for Students and General Readers. By E. G. Bilham. Pp. xix + 347. (London: Macmillan and Co., Ltd., 1938.) 21*s.* net.

IN this book Mr. Bilham, superintendent of the British Climatology Division of the Meteorological Office, sets out to compile a reasonably complete summary of the main climatic features of the British Isles within the compass of a book of reasonable size. The book runs to 339 pages, and achieves in a marked degree the avowed intention of the author, and so meets a very long-felt want of meteorologists and geographers. It contains a wealth of information of a statistical character concerning the climatic elements of importance, all discussed and compared in a clear and interesting manner. Much of the information contained in the book has not hitherto been available in printed form, while still more was only available in the rather arid form of such publications as the "Book of Normals".

The book begins with a discussion of the nature of the observations to be treated. Here we find mention of a point all too frequently ignored, that the meteorologist's fog, meaning visibility of less than 1,000 yards, is not of necessity fog to the ordinary man. The motorist, for example, thinks of a fog as a condition which seriously interferes with driving, which corresponds with visibility less than 100 yards.

Mr. Bilham describes the evaluation of the standard deviation and probable error of rainfall statistics, pointing out that the use of these parameters involves the assumption that the data fulfil the normal law of error, which, he says, is not likely to be strictly true. This is obviously so of rainfall, since rainfall is of necessity a positive quantity, while amounts of double the mean are by no means rare. It would therefore have been of interest to know how wide of the truth the assumption of a normal distribution really is. The author has treated the type of distribution of pressure, in accordance with Gold's classification, as a climatic element, the frequency distribution of which at different times of the year is given. This is a new departure in a text-book of climatology, and a welcome one.

Without going into the details of the contents of the book, we may say that the data for wind, rainfall, evaporation and run-off, temperature, sunshine and cloud, humidity, ground frosts, snow, hail, thunderstorms, and visibility, are given as fully as can be expected in any text-book. The mass of data concentrated into these pages bears testimony to the skill of the author, as well as to his mastery of the subject. Although the book is perhaps to be judged as a collection and discussion of the facts of observation rather than as an introduction to general climatology, it is readable and interesting. It will prove not only useful as a text-book for the meteorologist and geographer, but will also be extremely useful to the research worker who desires to know at what point to take up the climatology of any special region.

So much being given, it may appear ungrateful to ask for more. In discussing wind data, Mr. Bilham gives on p. 59 a table of the frequencies of winds of different velocities for January, July and the whole year. The reader who is likely to make real use of the data for January and July is also likely to want similar data for the other months of the year, and it would be possible to suggest a number of uses for such tables for each month of the year, for a number of places distributed over the British Isles.

The occasions of very high wind, of very heavy rain, of abnormally high or low temperature, are shown in convenient tables, and these tables should enable the weather correspondents of the daily newspapers to check up their frequent comparisons with record occasions. In passing, the author stays to scoff at the dew-pond, pointing out that the main factor in the maintenance of the high level in the pond is the fact that it collects rain from a much greater area than the surface

area of the water exposed to evaporation. This fact is probably enough to account for the observed phenomena, but it might also be pointed out that any comparison of the dew-pond with the actual formation of dew on grass should be restricted to the dew which *falls*, since over the pond there is no phenomenon corresponding to the dew which is formed by condensation from the air rising from the soil.

The final chapter of the book is devoted to the special types of climate, such as those of coastal areas, inland areas, valleys and towns; and an appendix gives for thirty-nine stations a synopsis of monthly data of cloud, visibility, temperature, rainfall and sunshine. This table, giving as it does the most recent determinations of the normal values of these factors, is one of the most valuable features of the book.

Mr. Bilham's book is one of the most useful additions to the meteorologist's library which has appeared in recent years. Although it is to be judged as a summary of the climatological data for a restricted area rather than as a discussion of the physical principles of climatology, the author's keen sense of the relative importance of the various factors of climate has led to the interpolation of remarks which are of the utmost importance to the clear understanding of the data. The attention directed to the importance of gust-level as compared with mean wind in determining the damage caused by wind, might be cited as an example of such happy interpolations. For a first edition the book is remarkably complete, particularly in view of the fact that it is the first serious attempt to produce a climatology of the British Isles.

D. BRUNT.

Popular Science

(1) The Advancing Front of Science
By George W. Gray. Pp. xiii + 364. (New York and London: McGraw-Hill Book Co., Inc., 1937). 12*s*. 6*d*.

(2) Frontiers of Science
By Carl Trueblood Chase. Pp. xv + 340 + 19 plates. (London: English Universities Press, Ltd., 1937.) 12*s*. 6*d*. net.

(3) The Universe Surveyed: Physics, Chemistry, Astronomy, Geology
By Harold Richards. Pp. xvii + 722. (London: Kegan Paul and Co., Ltd., 1938.) 12*s*. 6*d*. net.

TO those who would like to see not only scientific knowledge but also scientific action play its part in developing civilization, popular science literature is a painful subject. So much of it is either inaccurate or unscientific. Admittedly technical writing on any technical subject is easier than accurate non-technical writing on the same subject.

The bulk of the science literature for the general reader happens to be prepared by two quite different classes of writer, the journalist and a few very distinguished men of science. The journalist has a very difficult task in that he may be unable to read the original research papers and economic pressure may prevent his taking too much time in understanding their subject-matter. The distinction between observable facts and interpretations of facts is likely to be completely lost. Moreover, he is apt to seek only those parts of scientific research which have news value.

On the other hand, the expert scientific workers, with one or two notable exceptions, have so far chosen to present to the general reader a very little that is science with much that is philosophy or mysticism. Even a little theology may be introduced. Both classes of writer use freely, without definition, such highly technical philosophical terms as *truth*, *existence*, *reality*, and *values*, where equally technical but more easily definable scientific terms are carefully avoided. It is not, therefore, surprising that outside the research laboratory there is little or no idea of what is typically scientific action and what is not.

(1) The first of these three volumes, "The Advancing Front of Science", by G. W. Gray, is specially welcome. Although written by a journalist, it is outstanding for its clear and generally accurate account of recent researches. Attention is directed to current work in representative fields of science, the earlier parts of the researches having been dealt with in the author's preceding book. From the nature of the writing, and from the three-page list of acknowledgments, it is clear that the information has been sought in the laboratories in America where the researches were carried out. Mr. Gray has been fortunate, not only in his opportunities of consulting many of the leading workers in America but also in his powers of grasping and conveying to the reader the results of his contacts. The choice of topics ranges from cosmic and atomic physics to recent developments in acoustics, chemistry and biology.

Sometimes the personal element is introduced, as in the chapter dealing with Langmuir's work on thin films, where biographical details are also given. There are occasional slips. For example, when referring to man's inability to survive for long a small change in his body temperature, the phrase "a 1 per cent change" in temperature is used

(p. 20). Then again, on p. 179, "These two separated hydrogen atoms, with their natural affinities now loose and unsatisfied, were eager for any kind of union". It is surely difficult for any scientific investigator to tell whether or no atoms are 'eager'. There is also the customary carelessness in using technical philosophical terms. In spite of these slight blemishes, the volume can be very strongly recommended.

(2) The scope of the second volume, "Frontiers of Science" by C. T. Chase, is very similar. Yet in spite of its excellent illustrations, the account is much less vivid. To the reviewer it savours more of the atmosphere of the science library than of the research laboratory itself. If popular science writers insist on using animistic explanations in physics, would it not help to push the method to its logical conclusion? Mr. Gray's atoms can be 'eager'; Mr. Chase's electrons can 'make decisions'. "What happens when an electron decides to break away from an atomic nucleus?" (p. 249).

(3) Instead of bringing animistic explanations up to date by giving atoms and electrons instincts or Œdipus complexes and the like, Prof. Richards in "The Universe Surveyed" seems, on p. 5, to go back to the early appeal to what is 'natural', giving, incidentally, vectorial qualities to hydrostatic pressure. "It is natural for water to run down hill. This is a consequence of the tendency of water to flow in the direction of the greater pressure." The writing is so 'bright' that it is sometimes difficult to tell which passages are offered as explanations and which as rhetorical devices planned to ridicule.

'Why' questions are frequently asked. "Why do we fall when the foot-bridge breaks under us? . . . the answer itself, when finally discovered, was found to link us with the stars" (p. 17). Such a passage is apt to give the impression that the scientific investigator can answer 'Why' questions and moreover that the finality of a scientific explanation can be determined. The most noteworthy features of the book are its many excellent illustrations and the inclusion of a section on geology. The title is much too comprehensive in that the universe surveyed is chiefly the non-biological part of the universe. Even vitamins and hormones are treated chiefly from the chemical point of view and psychology is barely mentioned.

The outstanding excellence of Mr. Gray's book overshadows all except the illustrations of the other two volumes. W. H. GEORGE.

Human Ecology

Life as a Whole

By Dr. J. W. Bews. Pp. ix + 347. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 15*s*. net.

PROF. BEWS' book is very difficult to review and, but for the evidence of the accomplished fact, might have been thought impossible to write. It is intended to supplement his previous work "Human Ecology", which was a study of man in relation to his environment—material, social and cultural. The present work is an attempt at a more complete synthesis. It is written explicitly from the point of view of General Smuts's theory of 'Holism'. The development of mankind is considered as the construction or creation of new 'wholes', whether these are mechanical inventions, social institutions, scientific and philosophical theories, or works of art. The author's general conclusion is that all human constructions are imperfect and may have to be pulled down and reconstructed. The pulling down may necessitate temporary reversion to more primitive and simpler conditions.

Perhaps the least satisfactory parts of the book are the chapters dealing respectively with social life and institutions, history and philosophy, art, architecture, music, literature. Twenty pages or so are devoted to describing the endeavours of the whole human race in each of these directions. The reader who knows about the subject is likely to be exasperated and the reader who does not bewildered. At almost any point he will be likely to ask: Why is this put in and why is that left out?

One does not know whether to praise Prof. Bews for his courage or condemn him for his rashness. Yet it is hard to see what else he could do. If the chapters had been expanded to two hundred pages or contracted to two, it would probably have been worse. That is one of the reasons why a book of this kind seems impossible to write.

The earlier chapters, the subject-matter of which may be roughly indicated by the term social psychology, are more satisfactory. Occasionally Prof. Bews may have chosen to follow opinions of doubtful reliability, but as he quotes his authorities this cannot do much harm. In any event we should be grateful to one who brings to his survey of mankind moderation, reason and sanity, at a time when these virtues are being extinguished in many quarters. A. D. R.

Sex and Personality:
Studies in Masculinity and Femininity. By Lewis M. Terman and Catherine Cox Miles, assisted by Jack W. Dunlap, Harold K. Edgerton, E. Lowell Kelly, Albert D. Kurtz, E. Alice McAnulty, Quinn McNemar, Maud A. Merrill, Floyd L. Ruch, Horace G. Wyatt. (McGraw-Hill Publications in Psychology.) Pp. xii+600. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 25*s*.

THE purpose of this work, which the authors regard as a pioneer attempt, is the accomplishment in the field of masculinity and femininity of something similar to Binet's early achievement in the field of intelligence, inasmuch as they have endeavoured to apply psychometric methods in the form of a test to the study of sex temperaments. The test was originally devised by the senior author, Lewis M. Terman, in 1922 in the investigation of intellectually superior children, and has since been applied in the examination of a great variety of groups, including college students, office workers, athletes, delinquents, homosexuals and prostitutes, the ages ranging from early adolescence to extreme old age.

The test is made up in two equivalent forms, *A* and *B*, and is composed of 910 items of the *questionnaire* variety, 456 in form *A* and 454 in form *B*. Although the test does not differ radically from previous methods in the study of sex differences, it represents a more systematic attempt to sample sex differences in a large variety of circumstances. The authors maintain that the types of investigation in which the test should be helpful include the relationship of masculinity and femininity of temperaments to body build, metabolic rate and other physiological factors, excess or deficiency of gonadal and other hormone stimulation, and homosexual behaviour, and to such environmental influences as parent-child attachments, number and sex of siblings, sex of teachers, type of education, marital compatibility and choice of friends or of occupations.

Philip's Biology Wall Charts
Designed and Drawn by the Rev. R. A. Ellis and A. E. Ellis. A. 1: Flower Colour. A. 2: Plumage Colour. A. 3: Shell Colour. A. 4: Comb Characters. B. 5: Skull of Dog. B. 6: Skull of Dog. B. 7: Skeleton of Rabbit. B. 8: Skull of Rabbit. B. 9: Rabbit: Ribs, Sternum, etc. B. 10: Rabbit: Limb Bones. C. 11: Protozoa. C. 12: Earthworm: General Anatomy. C. 13: Earthworm: Transverse Section, etc. C. 14: Frog. D. 15: Green Algæ. D. 16: Leaf. (London: G. Philip and Son, Ltd.) Double Charts, 11*s*. 6*d*. Single Chart, 6*s*. 3*d*.

THE difficulty of finding English diagrams suitable for the teaching of biology in schools is a byword amongst teachers of the subject. Philip's series will do something to remove the complaint. They are diagrammatically accurate, bold in design and colouring (although a little crude), well lettered, and of a size (24 in. × 38 in.) suitable for all except large laboratories and class-rooms. The series of sixteen charts contains four illustrating Mendelian inheritance, although unfortunately none shows a simple case of dominant and recessive characters, six are of skeletons or parts of skeletons, four illustrate common zoological types, and two are botanical. In making a selection for this limited series the designers wisely chose subjects which do not readily lend themselves to blackboard illustration. The charts are mounted on cloth and may be obtained at the same prices dissected to fold in four, or varnished with a roller; varnished diagrams, however, are useless in many laboratories because of light reflections from the glazed surface.

Schicksalsstunde Europas:
Erkenntnisse und Bekenntnisse, Wirklichkeiten und Möglichkeiten. Von Karl Anton Prinz Rohan. Pp. 432. (Graz, Wien und Leipzig: Leykam Verlag, 1937.) 7 gold marks.

PRINCE ROHAN is not content to live on the reputation of a historic name: he has won himself a prominent place as a writer on political philosophy. At the beginning of his philosophical career, Prince Rohan stood for free international co-operation. But the drift of events during recent years has modified his attitude to the extent of subordinating everything to a fight against communism. In the present work, which deserves to be translated into English, Prince Rohan begins with Europe's inescapable burden laid on it by centuries of tradition. Delving into the heart of mankind, he traces its hesitations between atheism and the search for God. From all this emerges his picture of twentieth-century man—a being torn between a dozen conflicting tendencies, between Christianity, socialism, liberalism, fascism, nazism and communism. To him the threat of communism is so great that only a vigorous antidote will counter. Hence his justification of nazism and the importance of the idea of 'race' which permeates it. Though everyone will not agree with Prince Rohan's views, his exposition is worth attention, and few would fail to benefit from the reading of "Europe's Hour of Destiny".

The Clear Mirror:
a Pattern of Life in Goa and in Indian Tibet. By G. Evelyn Hutchinson. Pp. xi+171+13 plates. (Cambridge: At the University Press, 1936.) 8*s*. 6*d*. net.

IN the three essays which make up this volume, the author, a member in 1932 of the Yale North India Expedition under the leadership of Dr. H. de Terra, records some of his impressions of travel. Of these the first, "Spain at Sea", deals, as its title may suggest, with the voyage to India and the life of Goa, with its former colonial splendours; the second, "Paintings on a Fan", the fan being the plain country of the north Indian foothills, describes Ladakh and the temples, with their paintings and ritual dances of Leh; and the third, "Lakes in the Desert", is concerned with the more picturesque and imaginative aspect of physiographic conditions in the upper regions of the Indus Valley. The author has a keenly observant eye for form and colour, and within the limits he has imposed, his essays are vivid pieces of description.

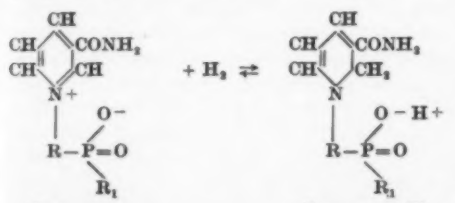
The Intermediary Reactions of Fermentation*

By Prof. Otto Meyerhof, For. Mem. R.S., Physiology Department, Kaiser Wilhelm Institute for Medical Research, Heidelberg

IN what way and by what mechanism is the sugar molecule transformed in the cell under anærobic conditions into its biological end-products, alcohol and carbon dioxide in the case of yeast, or lactic acid in the case of muscle? The different kinds of anærobic breakdown of carbohydrate are so closely related, the anærobic formation of lactic acid especially offers so many analogies to alcoholic fermentation, that the discussion of one will throw much light on the other.

Just as a cell-free yeast extract could be made according to the prescriptions of Buchner and Lebedew, so a glycolysing extract of muscle could be obtained and both systems could be divided further. The co-enzyme systems could be removed by dialysis and the protein residues could be fractionated in various ways. In addition to such fractionation, it is possible to suppress certain enzyme reactions by specific poisons, leaving others undamaged, and by other means to remove from further reaction certain intermediate products. At the end, one arrives at certain elementary or primary reactions by which, step by step, substances structurally adjacent are converted one into the other.

In these intermediary reactions, four different types are obvious. The most familiar type is oxidation-reduction. This oxidation-reduction is confined to three distinct reactions, which are connected by the cozymase of Harden and Euler. The chemical constitution and the function of this cozymase have been revealed by Otto Warburg during the past year. The cozymase was identified as diphosphopyridine-nucleotide, where the H_2-carrying group is nicotinic acid amide (scheme 1).



Cozymase. Cozymase−H_2.

R = Ribosephosphor. ac. R_1 = Adenosine.

(1)

The reduction process consists of the conversion of acetaldehyde, which arises in fermentation, to alcohol. The oxidation has been achieved by O. Warburg with hexosemonophosphate; but in fermentation this monophosphate is not the molecule which reacts directly with cozymase but a more remote primary product. The oxidation process, which reduces the cozymase, consists of the conversion of triosephosphate (more exactly glyceraldehydephosphate) into phosphoglyceric acid. The oxidation-reduction consists of the *reduction* of aldehyde to alcohol, and the *oxidation* of phosphorylated aldehyde to phosphorylated carboxy acid. This is the oxidation-reduction in the stationary state of fermentation where acetaldehyde is already present as split product of pyruvic acid. In the beginning, during the so-called induction period, the phosphoglyceric acid arises by the dismutation of triosephosphoric acid alone, while simultaneously α-glycerophosphoric acid is formed as reduction product. This dismutation also is brought about by cozymase.

The yeast dialysate, designated originally as coenzyme of fermentation by Harden, does not contain only the cozymase, but several other constituents as well. One of these is a second coenzyme which also can be regarded as the dissociable active group of an enzyme, namely the phosphorylating coenzyme. This coenzyme is the so-called adenylic system. It consists of three parts: (*a*) adenylic acid (adenosinmonophosphate), (*b*) adenosindiphosphate, and (*c*) adenosintriphosphate.

The last two substances were discovered by K. Lohmann in our Institute. The transfer of phosphate is brought about by adenylic acid or adenosindiphosphate taking up phosphate, and adenosintriphosphate giving it off. The substance which accepts phosphate from adenosintriphosphate is hexose. It first becomes hexosemonophosphate and then hexosediphosphate, the well-known ester of Harden and Young. On the other hand, only one substance gives off phosphate. This is the precursor of pyruvic acid, phosphopyruvic acid. In splitting phosphopyruvic acid, the phosphate group is transferred to a sugar or hexosemonophosphate molecule, according to the following scheme (2).

A. 2 phosphopyruvic acid + adenylic acid = 2 pyruvic acid + adenosintriphosphoric acid

B. 2 glucose + adenosintriphosphoric acid = 2 hexosemonophosphoric acid + adenylic acid

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$C = \frac{A+B}{2}$ phosphopyruvic acid + glucose = pyruvic acid + hexosemonophosphoric acid

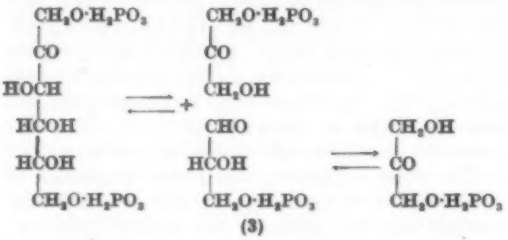
D. phosphopyruvic acid + hexosemonophosphoric acid = pyruvic acid + hexosediphosphoric acid

(2)

* Extracted from a lecture given at the staff meeting of the Rockefeller Institute for Medical Research, New York, on October 15, 1937.

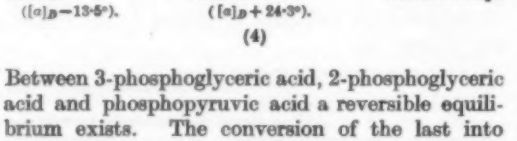
This chain of reactions goes very much faster than the direct splitting into pyruvic acid and inorganic phosphate, and is a typical example of transfer of phosphate.

The oxidation-reduction and the phosphorylations are the most important links of the reaction chain from the energetic point of view, but with these two types of reactions the series is not yet complete. If one removes all coenzymes by dialysis, such an extract is inactive towards hexose, also towards hexosemonophosphate, but not towards hexosediphosphate. In 1934, I found, together with K. Lohmann, that hexosediphosphate enters a very fast reversible reaction, namely hexosediphosphate ⇌ 2-dihydroxyacetonephosphate. Here the 6-C chain is split reversibly into 3-C chains. The closer investigation of this remarkable reaction revealed the fact that it must be separated into the two reactions given in scheme 3.



(3)

In the first reaction, one half of the molecule is converted into 3-glyceraldehyde-phosphate, synthesized by H. Fischer two years earlier. This 3-glyceraldehyde-phosphate is then largely converted into dihydroxyacetone-phosphate. In the opposite direction the two trioses react by enzymatic aldol condensation to form hexosediphosphate. The other reversible reactions described below are also independent of a coenzyme. In 1933 Embden discovered shortly before his death that phosphoglyceric acid is converted enzymatically into pyruvic acid and phosphate. The closer investigation of this Embden reaction taught us that here also a reaction chain occurs which must be formulated as in scheme 4.

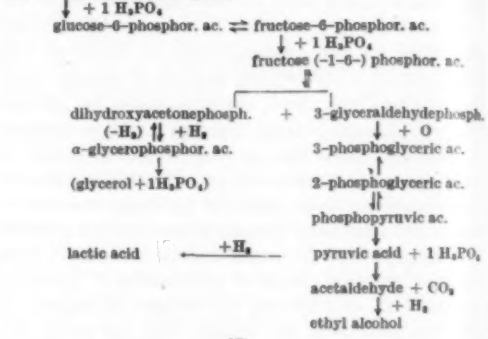


(4)

Between 3-phosphoglyceric acid, 2-phosphoglyceric acid and phosphopyruvic acid a reversible equilibrium exists. The conversion of the last into pyruvic acid is an irreversible dephosphorylation, as I have already stated.

In pursuing the further fate of the pyruvic acid we meet the fourth type of fermentation reaction, the breakdown of pyruvic acid into acetaldehyde and carbon dioxide by the well-known carboxylase of Neuberg. This carboxylase also has a dissociable group which was identified by K. Lohmann a short time ago as the pyrophosphate of aneurin (vitamin B_1).

I have put down all these intermediary products in scheme 5, where the chemically adjacent substances follow each other directly. Every substance is distinguished from the preceding one either by one phosphate group, one carboxyl group, one water group, an oxidative stage, or the neighbouring position of phosphate. Any other stable intermediates are, therefore, highly improbable.



(5)

Does this scheme also indicate the pathway by which in the stationary state the breakdown really proceeds? I can answer the question in the affirmative. Some investigators claimed the hexosemonophosphate to be the reactive form of sugar, because it ferments more rapidly than does the Harden–Young ester. Some time ago I myself was also in favour of this opinion. On the other hand, the ester of Harden–Young was not popular in this respect, for the reason that it ferments very slowly and does not decrease during the rapid period of fermentation, but even accumulates, which seems strange for an intermediary product. Only in the past year have we succeeded in solving this paradox by the closer study of the so-called 'fermentation test' of Warburg and Christian.

These investigators have obtained from maceration juice of yeast two different fractions of protein, partially purified, so-called *A*- and *B*-proteins, which, together with the total system of coenzymes, are able to decompose hexosemonophosphate in the presence of acetaldehyde into phosphoglyceric acid and pyruvic acid. (The carboxylase is removed by this fractionation.) Glucose alone and also hexosediphosphate alone remain practically unattacked in this fermentation test. It appeared as though hexosemonophosphate by the

interaction of acetaldehyde would split into two oxidized halves, namely, pyruvic acid and phosphoglyceric acid. This finding contradicted all our experience, according to which the whole of pyruvic acid is derived from phosphopyruvic acid. The study of this fermentation test had an unexpected result: it could be proved with convincing evidence that the structural chemical sequence of substances is identical with the pathway of breakdown. Why, I should like to ask, can hexosemonophosphate be metabolized only with both protein fractions *A* and *B* together? This follows, as our experiments show, from the fact that the so-called *A* protein contains that enzyme which in co-operation with the adenylic system enables the phosphate transfer in equation *F* of scheme 6.

E. 1 hexosediphosphoric acid
$$\Downarrow$$
2 triosephosphoric acid + 2 acetaldehyde + 2 glucose + 2 H_3PO_4
$-$ 2 phosphoglyceric acid + 2 alcohol + 2 hexosemonophosphoric acid

F. 2 hexosemonophosphoric acid + 2 phosphoglyceric acid
$-$ 2 hexosediphosphoric acid + 2 pyruvic acid

G = *E* + *F* : 1 hexosediphosphoric acid + 2 acetaldehyde + 2 glucose + 2 H_3PO_4 $-$ 2 pyruvic acid + 2 alcohol + 2 hexosediphosphoric acid

H = *G* + carboxylase : 1 hexosediphosphoric acid + 2 glucose + 2 H_3PO_4 $-$ 2 CO_2 + 2 alcohol + 2 hexosediphosphoric acid

(6)

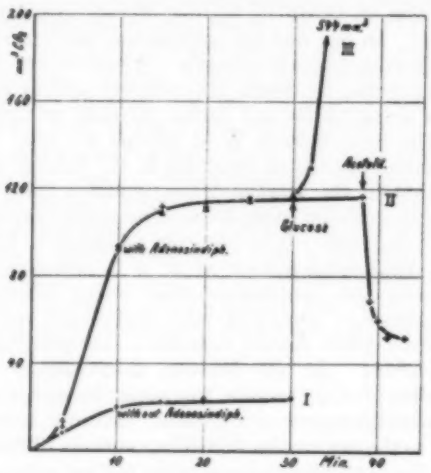
If no hexosediphosphate can originate, no fermentation takes place because hexosediphosphate is the only source of triosephosphate. Accordingly, a fermentation comes about with *B*-protein alone, if one starts with a mixture of glucose and hexosediphosphate, since now the hexosediphosphate can be decomposed into triosephosphate (*E* of scheme 6). Two molecules of triosephosphate, which originate from the rapid breakdown of one molecule of hexosediphosphate, are oxidized by acetaldehyde to phosphoglyceric acid; the acetaldehyde is reduced to alcohol, while simultaneously two molecules of glucose are esterified to hexosemonophosphate. On subsequent addition of the phosphorylating enzyme, that is, the *A* protein, the above-mentioned reaction *F* will be obtained. Hexosemonophosphate takes up phosphate from phosphopyruvic acid which originates from phosphoglyceric acid. When we sum up equations *E* and *F* and consider that two molecules of triosephosphate are equal to one molecule of hexosediphosphate, we obtain the balance equation *G* of scheme 6. In this balance, hexosemonophosphate and phosphoglyceric acid are cancelled as intermediates, since they appear on both sides. Now, for the turnover of two molecules of glucose we get one molecule of hexosediphosphate in addition; but while equation *E* indicates a stoichiometrical reaction, this is no longer the case with equation *G*. Hexosediphosphate increases autocatalytically and always reacts anew by way of triosephosphate according to equation *E*, until another component, for example glucose or inorganic phosphate, is completely consumed.

Equation *G* is nothing but the fundamental reaction on which the Harden–Young equation is based. In our case the carboxylase was removed by fractionating the proteins. When we add this carboxylase, by which the pyruvic acid is split into acetaldehyde and carbon dioxide, we arrive at the total balance *H* of scheme 6. Now the acetaldehyde also is cancelled in the balance and we obtain the Harden–Young equation itself by merely removing one molecule of hexosediphosphate from each side. It is, however, advisable to leave this hexosediphosphate as it is in equation *H*, because this emphasizes that really hexosediphosphate is converted into alcohol and carbon dioxide, while glucose represents the acceptor of phosphate. In the balance, according to the Harden–Young reaction, free sugar disappears and hexosediphosphate accumulates. However, according to the mechanism it is in fact entirely different, for the hexosediphosphate is the mother substance of the triosephosphate which reacts directly with cozymase, while glucose is being converted into diphosphate by way of hexosemonophosphate, according to equations *E* and *F*. I remind you of a finding obtained twenty years ago, that maceration juice free from autofermentation does not decompose sugar, without a trace of hexosediphosphate having been added in the beginning. This is the hexosediphosphate on the left side of equation *H*.

In respect to the fermentation of hexosemonophosphate studied by Warburg, it can also be shown that the mechanism is the same. The hexosemonophosphate is at first converted into hexosediphosphate by taking up phosphate, and equations quite analogous to those demonstrated are valid. As a matter of fact, the pyruvic acid which appears in this fermentation of hexosemonophosphate has derived from phosphopyruvic acid by the transfer mechanism of phosphate, as shown in equation *F* of scheme 6.

It is always the triosephosphoric acid which reacts directly with cozymase. But this reaction proceeds slowly by itself, and is rapid only in the presence of a substrate functioning as acceptor of phosphate. A most convincing demonstration can be given by substituting creatine for glucose in the fermentation system of hexosediphosphate. Creatine, as is well known, is not present in yeast, but it is of fundamental importance in the lactic acid formation of muscle as acceptor of phosphate. If one adds to the *B* protein of Warburg, in addition to the different coenzymes,

hexosediphosphate and creatine and a little of the specific enzyme which enables the phosphate transfer from adenylpyrophosphate to creatine, hexosediphosphate will now be decomposed into pyruvic acid as rapidly as in the presence of glucose.



MANOMETRIC DETERMINATION OF REDUCTION OF COZYMASE BY TRIOSEPHOSPHORIC ACID IN PRESENCE OF *B*-PROTEIN. CARBON DIOXIDE LIBERATION FROM SODIUM BICARBONATE BY H+ OF REDUCED COZYMASE AND H+ OF PHOSPHOGLYCERIC ACID.

The specific relation between the oxidation-reduction and the uptake of inorganic phosphate, which has also impressed other investigators, can be traced to a coupling of the reduction of cozymase and the phosphorylation of adenylic acid or adenosindiphosphate to adenosintriphosphate. When we omit acetaldehyde from our system and employ triosephosphate and cozymase in equivalent amounts, only a very slow reaction takes place; but this reaction is accelerated enormously as soon as either a larger quantity of adenosindiphosphate or an excess of glucose with a trace of an adenylic compound is added. In the accompanying diagram the course of this conversion is demonstrated.

The measurements were made with manometric technique. The second curve is with a large amount of adenosindiphosphate. The steep upward branch of the curve shows the effect of adding glucose as indicated. This interacts with the adenosintriphosphate formed by phosphate transfer to adenosindiphosphate. The curve sloping downward shows the effect of adding acetaldehyde, by which the reduced cozymase is reoxidized. In addition to this manometric method, the hydrogenation of cozymase can be measured spectrographically. As discovered by O. Warburg, the reduced cozymase has a broad absorption band at 340 mμ, which is lacking in the oxidized form. From the breadth of the band the amount of reduced cozymase can be calculated. Thus, by different methods one arrives at the equations in scheme 7.

J. 1 triosephosphate + 1 Cz + 1 adenosindiphosphate + H_3PO_4 = 1 phosphoglyceric acid + 1 CzH_2 + 1 adenosintriphosphate

K. 1 adenosintriphosphate + 1 glucose = 1 adenosindiphosphate + 1 hexosemonophosphate

L = *J* + *K*. 1 triosephosphate + 1 Cz + 1 Glucose + 1 H_3PO_4 = 1 phosphoglyceric acid + 1 CzH_2 + 1 hexosemonophosphate

(7)

Always we obtain an equivalence between esterified phosphate, reduction of cozymase, and formation of phosphoglyceric acid. The profound cause for this coupling between the adenylic system and the reduction of cozymase (equation *G*) remains to be explained.

Basin Cultivation in the United States

By Lois Olson, Soil Conservation Service, United States Department of Agriculture

IN an article entitled "Soil Conservation in Tropical Africa" (NATURE, **141**, 268–270; Feb. 12, 1938), Dr. L. Dudley Stamp described a basin type of cultivation that is in practice in Northern Nigeria. In conclusion he states, "If America could invent a plough which will imitate the Nigerian system by replacing the long furrow by a series of isolated elongated basins, one at least of her major problems in the dry lands of the Middle West might be solved". Actually, the principle of basin cultivation described by Dr. Dudley Stamp has been the subject of experimentation in the United States for the last ten years, and to-day several basin cultivators are on the market and in use by farmers in various parts of the country.

So early as 1927, Mr. C. T. Peacock, a Colorado ranch owner, developed a basin lister* which proved satisfactory on his land. The damming attachment consisted of a drag which followed the cutting blade. At intervals the drag was lifted,

* A double mould board plough.

Fig. 1.
THE BASIN LISTER IN OPERATION IN A CALIFORNIA ORCHARD.

leaving dams across the furrows. A patent was obtained in 1931. In the spring of this same year, Mr. R. H. Davis began work on a hole-digging cultivator at Hays, Kansas, and by the autumn of the year an improved model of the implement was sent to the Soil Erosion Experiment Station, Pullman, Washington, for testing. Although the machines were operated on entirely different principles, they served much the same purpose in the semi-arid sections of the country. The cultivator, which dug holes of about ten-gallon capacity, was designed primarily to retain moisture and check erosion on fallow land but later proved effective in orchards, particularly in California. Because of the pock-marked appearance of the fields, it was commonly known as the 'waffle' cultivator, and during 1931 it received considerable attention in the Press. Almost simultaneously, but completely independently, a machine which accomplished the same ends was designed in Hawaii.

In 1934 experimentation was begun on another type of basin lister at Ames, Iowa, by the Bureau of Agricultural Engineering, in co-operation with the State Experiment Station. This work was performed under the direction of J. B. Davidson, C. K. Shedd and E. V. Collins. A rotary, paddle-like attachment was used for constructing the dams.

The basin lister has several advantages over the hole-digging cultivator. The furrows, being larger than the holes, retain a larger amount of water and fill with sediment less readily. Most farmers in the Great Plains area already own listers, and the damming unit may be purchased separately and attached to an ordinary lister. Plans and specifications for the construction of a home-made damming attachment are also being distributed by the Fort Hays branch of the Kansas Agricultural Station.

The use of the basin lister raises several practical problems. If it is used for corn, the water retained in the furrow may cause the soil to form a crust on the top. If so, the young shoots may not be able to break through and an imperfect stand results. After the corn has started growth, the subsequent cultivations tend to break down the ridges between the furrows, and during the last cultivation the ridges are practically destroyed. After harvesting the corn, the land is consequently left unprotected until it is again cultivated in the spring. This means that the soil has no protection during three fourths of the year. In other circumstances dams that have been left standing present obstacles to subsequent cultivation, but several simple types of 'dam busters' have already been devised.

The space occupied by the dams reduces the water-holding capacity of the furrows, the reduction being in proportion to the space occupied by the dams. The spacing of the dams would necessarily vary with the amount of rainfall and

Fig. 2.
BASIN LISTING NEAR HAYS, KANSAS.

with the position of the furrows. The closer they approach to the contours the longer the furrows may be and the greater will be their storage capacity.

As yet the basin cultivator has not been adapted to grains such as wheat, since there is no seeding device capable of planting the seeds at the different depths that would be required on a field prepared by a basin cultivator. The objections advanced, however, are not serious enough to prevent the use of the basin lister for other crops or to discourage further experimentation.

Science and Industry at the Empire Exhibition, Glasgow

THE exhibits in three of the large exhibition halls in the United Kingdom Government Pavilion at the Empire Exhibition, Glasgow, opened by H.M. the King on May 3, have been arranged by the Department of Scientific and Industrial Research in close collaboration with industry. The aim of the halls is to show the relationship now existing between science and industry, and the part which science has played in the development of British industry. The theme is illustrated by the three great national industries of coal, iron and steel, and shipbuilding—one of the exhibition halls being devoted to each of these industries. The subjects of the halls were chosen on the advice of a committee which included some of the greatest industrial leaders in the country.

In telling the story of the place which science is taking in modern industry, practically every device of modern display has been employed to make the exhibits attractive and interesting. In this work the Department has had the help of a distinguished display expert.

Everywhere the visitor finds colour and movement. Complicated processes are simplified and traced out for him by moving lines of light. Where possible, working models are used, and elsewhere essential points are explained by short cinema films introduced into the various sections of the exhibit. The meaning underlying the halls is made plain by large murals. Many of the exhibits are demonstrated by members of the staff of the Royal Technical College, Glasgow. A novel feature of the halls is, that in the sections where a demonstrator is not provided, the various exhibits are explained in conversational tones by loudspeakers radiating the story of the section and directing attention to the various points. For this purpose a new system of sound recording employing a narrow strip of film is being used.

The first of the three industrial research halls is devoted to coal. The most prominent single exhibit in the hall is a large working model of a coal mine more than 200 square feet in area and fifteen feet in height. This has been provided for the Pavilion by the Mining Association of Great Britain, and is probably the finest model of its kind in the world. Both underground and surface workings are illustrated in detail. The latest methods of winning coal are demonstrated and near by are exhibits illustrating the work of the Safety-in-Mines Research Board and the Miners' Welfare Committee. There are also sections dealing with the preparation of coal for the market, which show that coal as supplied to the consumer to-day has ceased to be a crude raw material and has become more and more a semi-manufactured article. Entering the hall, there is a section dealing with the origin of coal. Here there is a large representation of what a coal forest looked like some two hundred million years before the appearance of man. A short cinema film shows how the debris of such a forest was converted into coal seams. The immense varieties of British coal are illustrated by a number of pillars cut from various coal seams. In the next section of the hall the work of the National Coal Survey is illustrated, and the way in which the immense amount of knowledge now available concerning the properties of coal is being used for its better utilization. The next section deals with the great advances which have been made in the use of coal for steam generation both in large power stations and in smaller industrial plants. Here, for example, it is shown that the amount of electricity which can be obtained from a ton of coal has increased by more than 60 per cent in the last twelve years and that, in addition, improvements in electric lamps and other appliances enable electricity to be used more economically. An interesting display shows the products of combustion in super-power station practice, in good and bad industrial practice, and in domestic heating. Something of the latest researches in domestic heating which are now being carried out is also illustrated.

The other side of the hall is devoted entirely to an exhibit prepared by the British Gas Federation dealing with the carbonization of coal in gasworks, coke ovens and low-temperature carbonization plants. The whole process of the treatment of coal and also many of the by-products

produced are shown. The essential parts of the various plants are represented, and the course taken by the coal into these is traced by moving light. Light of a different colour shows the passage of the gas through the various stages and the methods by which impurities are extracted from it and converted into valuable products. In front of these diagrams are scenes showing the industries in which these by-products of coal are used, and below these again are fascinating models showing the finished articles which coal has helped to make. The centre of the hall is taken up by a large section illustrating the modern use of coal as a raw chemical material. Various processes for obtaining oil from coal are illustrated here, and it is shown how the gases produced by passing steam over red-hot coke or coal can be synthesized into motor spirit, industrial alcohol and other products. The use of coal as a raw material in the carbide industry, in the production of active carbon and in the making of electrodes is also illustrated.

In the Iron and Steel Hall the visitor will find a huge model of a blast furnace more than thirty feet in height. The furnace itself is made in glass and reveals the red-hot charge within and the molten iron apparently running into the pig beds. The right-hand side of the hall is devoted to the production of iron and steel from the ore to the finished product. To enable the layman to appreciate some of the research problems involved, an attempt has been made to show something of what goes on inside the steel furnace. This has been done by the use of moving coloured models partly made in glass. They indicate, for example, the importance of the heat resistance of the brick linings of the furnace. Industry spends £3,000,000 a year in the replacement of these, which represents 5*s*. of the cost of every ton of steel made. Here is obviously a problem of research, in which, by the way, great progress is being made. The importance of controlling the various processes by scientific instruments is brought out and the ways in which science is helping towards improvements in efficiency and reduction of waste in every form.

Two sections of the hall deal with the microscope and X-rays. The use of the microscope to reveal the inner structure of metals is demonstrated, together with the way in which such knowledge is being used to produce stronger but lighter steels, besides steels possessing special properties. In the X-ray section a powerful equipment for X-ray analysis is shown working, and the visitor learns how, by this means, the physicist can deduce the actual arrangement of the atoms from which the crystals seen in the microscope are built up. Both the use of the microscope and the X-ray apparatus is demonstrated by the staff of the Royal Technical College, Glasgow.

Finally, the way in which steel is used for various engineering purposes is illustrated and an attempt is made to show the visitor how an engineer would select a steel for a particular job and the kind of forces the steel would have to withstand. Progress in constructional steels, for example, is illustrated by a series of model bridges of increasing span constructed of cast iron, mild steel and alloy steel. The load on the bridges consists of a model train. The visitor is reminded of the immense savings, amounting to many millions of pounds a year, resulting from the use of improved steels produced by scientific research, and of the way in which these steels are enabling what were once the luxuries of the few to be brought within the reach of millions. Just before the visitor leaves the hall, an interesting small section directs his attention to the increase in value of iron resulting from research and craftsmanship, which shows that iron in the form of iron ore is worth about 34*s*. a ton, while in the watch-spring, for example, it is worth perhaps £4,000,000 a ton.

In the Shipbuilding Hall the subject has been treated in three parts—the hull, the engines and navigation. Improvements in the lines of the hull have come about as the result of 'tank' research. There is a working model of the famous Yarrow Tank and the workshops associated with it at the National Physical Laboratory. While such a model brings out the length of the modern tank, it can convey very little idea of the actual type of the model hull used in the work or of the instruments employed. Accordingly a 16 ft. wax model of a hull fitted with the necessary recording instruments is also shown. Recent research on the phenomenon of cavitation is illustrated by a propeller-tunnel in which a propeller is shown running under conditions which produce cavitation.

Turning to the marine engine, working models of three of the latest types of turbine, reciprocating engine, and oil engine are shown. In another exhibit the development is traced of the steam engine and its efficiency from the time of Watt to the present day.

The results of research in shipbuilding are summed up in one section of the hall. Here it is shown that the fuel consumption of an ordinary cargo vessel of, say, 9,000 tons steaming at 10 knots, has been reduced by nearly half in the last fifteen years as the result of research. How this remarkable result has been brought about is shown by a representation of a cargo vessel of fifteen years ago, which fades before the eyes of the onlooker to the same type of ship as would be built to-day.

One of the most popular exhibits in the hall is a very realistic ship's bridge carrying the wheelhouse and chartroom of a cargo liner. Practically all the navigating instruments found on such a vessel, including the gyro-compass, the echo depth-sounder and the wireless direction-finder are arranged so far as possible to simulate working conditions. The visitor is able to handle these instruments and to have their principles explained to him by the 'captain', the 'chief officer' or the 'quartermaster'. Elsewhere in the hall the principles underlying some of these instruments are demonstrated in other ways. In this section also there is a fascinating display illustrating a cathode ray direction-finder which gives the bearings of a distant station instantaneously.

Another exhibit which is proving very popular is the wireless office of a British destroyer manned by naval ratings.

The large mural, 1,500 ft. square, over the exit of the hall is a striking example of the industrial co-operation which has made the exhibits possible. On this mural are displayed silhouettes of every vessel of more than 100 tons gross launched from British yards last year; they include liners, tanker vessels and smaller craft, besides warships of every description. Some four hundred ships, of capital value £46,000,000, are represented according to the town in which they were built. Every shipbuilding firm in the country has contributed to this remarkable feature by supplying silhouettes of the ships built in its yards.

Obituary Notices

Colonel Marcuswell Maxwell

COLONEL MARCUSWELL MAXWELL, who died suddenly in a Nairobi nursing home on April 21, was one of the most successful photographers of wild life in East Africa, his photographs of lions, elephants, giraffes, rhinoceroses and other big game being some of the best ever taken, while his photographic studies of the eastern gorilla have never been surpassed. He shared with his namesake, Marius Maxwell, the distinction of being not only a photographer but also a photographic artist in that nearly every exposure he made was a picture.

Maxwell's photographs of East African big game have from time to time appeared in the pages of *The Times* and were published in book form, in two volumes, by *The Times* in 1930. One of these volumes, entitled "Elephants and Other Big Game Studies", contains eleven magnificent photographs of the African elephant, the majority of which were taken at close quarters. These are followed by photographs of black rhinoceros, waterbuck, hunting dogs, hyaenas, impala, eland, zebra, giraffe, wildebeest and vultures. The other volume, entitled "Big Game Photographs", commences with a series of photographs of the well-known Serengeti lions, among them some of the most amazing close-ups of these large carnivora that have ever been secured. There is also an interesting study of a lion climbing a tree, showing that these animals do occasionally exhibit arboreal habits. In this volume, there are also photographs of a rhinoceros accompanied by tick-birds, giraffes in the open, a wonderful study of buffaloes in cover, two wart-hogs at home and a general view of waterbuck at a water-hole.

It is a sad coincidence that death should have overtaken both Marcuswell and Marius Maxwell, two of our most prominent animals photographers. They were not related, but their names and photographic work being so similar frequently led to confusion between the two. This was accentuated by the fact that, in addition to both photographing wild life in Kenya Colony, they both visited the Birunga range of volcanoes in the eastern Belgian Congo in the hopes of photographing the eastern gorilla. Here Marcuswell was more successful than Marius, the latter encountering abnormally bad climatic conditions even for these equatorial forests. Some of Marcuswell Maxwell's photographs of gorillas will never be bettered; he had the good fortune to come up close to an old male gorilla and his family, and without very much interference from the ground vegetation was able to take some excellent pictures.

Zoological science, naturalists and sportsmen have lost a very ardent worker in the death of Marcuswell Maxwell, and he leaves a blank which will be very difficult to fill.

GUY DOLLMAN.

Prof. J. E. Johansson

PROF. J. E. JOHANSSON, of Stockholm, died on March 31, at seventy-six years of age. Johansson was professor of physiology at the Caroline Institute in Stockholm from 1901 until 1927. His first degree was in physics and mathematics. He then studied physiology with Holmgren in Uppsala, and in 1889 he worked with Ludwig in Leipzig. In 1890 he was awarded his M.D. degree for a thesis on the splanchnic nerves and was appointed reader in Tigerstedt's laboratory at Stockholm. From 1890 until 1908, he carried out his well-known researches on metabolism, particularly in connexion with muscular exercise. From 1908 onwards, however, his spare time was chiefly occupied with various activities on behalf of the Swedish Government. He was chairman also (until 1926) of the Medical Nobel Committee, and the high standard which he maintained gave him an enormous amount of work in studying the claims of persons proposed for the Nobel Prize in physiology and medicine.

Johansson's works on social medicine are numerous. He revised and reformed the medical statistics of Sweden. As a member of a Government committee he worked very hard for the abolition of regulated prostitution in Stockholm and published a book on the subject "Sur la réglementation à Stockholm" 1912. The majority did not take his view and he had to fight alone, which he did with great vigour. In 1920 the Swedish Parliament passed a law which abolished it.

For many years, Johansson was a member, and later president, of the board for the Royal Gymnastic Central Institute, where he worked hard for the reorganization of the old institute and for the erection of a laboratory for the physiology of muscular exercise. It is hoped that the Swedish Government will provide for this shortly. He was chief adviser to the Board of Nutrition during the Great War.

Johansson was greatly beloved by his students and colleagues, and was a popular and well-known figure at international gatherings. He was president of the International Congress of Physiology at Stockholm in 1926 and chairman for many years of the Permanent International Committee of the Congresses. He attended the Harvey celebrations in London in 1928. He was an honorary member of the Physiological Society. For many years until his death he was chairman of "Idun", the well-known society of men of science, letters and art in Stockholm. He was an honorary member of the Medical Society of Sweden, honorary senator of the Polytechnical High-school of Dresden, and a commander of the order of the Belgian Crown. He received the degree of LL.D. from the University of Edinburgh in 1923.

Johansson's brothers were gifted men. The eldest is a mining engineer, the second became the youngest judge in Sweden, the third was a clergyman and the fourth, Harold, a well-known geologist. His sister was the wife of the famous Swedish chemist Arrhenius. Johansson never went to school, but was educated by his elder brothers and entered the University at the age of fourteen. Although a bachelor, his home was always full of young people, nieces and nephews, who nearly all of them spent years there when studying in Stockholm.

Johansson's scientific papers are published in various physiological journals, particularly the *Skandinavisches Archiv für Physiologie*, and in the text-books of Abderhalden, Zuntz and Loewy, and Hammarsten.

A. V. H.

Dr. Hermann Augener

DR. HERMANN AUGENER, of the Hamburg Museum, died on April 5 in his sixty-sixth year. The son of a merchant, he was born in Hamburg on October 2, 1872, and after doing his schooling in his native city went to Göttingen and afterwards to Munich to continue his scientific studies. Of independent means, he might have done anything he chose, but he decided to devote his life to marine zoology. He spent some time at the Zoological Station at Naples, and from there went as an assistant to the Zoological Institute of the University of Göttingen, where he remained for several years. His next and final move was back to his native Hamburg, where he became an unpaid, voluntary worker at the Hamburg Museum.

Augener was a specialist on the marine annelids or Polychæta and became a leading authority on the group. Most of his work was of a faunistic nature, and he did much not only to extend our knowledge of the group, but also to impose order upon its classification. He had great learning and an extraordinary capacity for accurate detail. He published about forty papers, many of great length, and among these the more notable are his work on the West Indian Polychætes, his volume on the Polychæta in the "Meeresfauna West-Afrikas", his contributions to Michaelsen and Hartmeyer's "Fauna Südwest-Australiens" and his papers on the Polychæta of New Zealand. At the time of his death, he was engaged on the Polychæta of the Dutch *Siboga* Expedition.

After the Great War, Augener had a severe struggle against poverty and ill-health. Married and with a family, he was left almost destitute by the collapse of the mark, but happily the Hamburg Museum came to his rescue with a small grant which enabled him and his family to live. In middle life he developed grave defects of hearing and eyesight. In fact, for about the last twenty years he was more than half-blind, and how, his eyesight being what it was, he carried on with his fine microscopic work, was known only to himself. That he did so may justly be described as heroic. He ploughed a narrow furrow to the end, and was without the reward of any public appreciation of his work, which was recognized only by his co-specialists.

Augener's is a gallant story.

C. C. A. M.

WE regret to announce the following deaths:

Prof. Max Neissen, professor of bacteriology and hygiene in the University of Frankfort-on-Main from 1914 until 1933.

Prof. P. A. Ross, professor of physics in Stanford University, who carried out work on X-ray spectroscopy, on March 20, aged fifty-four years.

Prof. L. W. Stern, professor of psychology in Duke University, formerly director of the Psychological Institute in the University of Hamburg, known for his contributions to child psychology, on March 27, aged sixty-six years.

Prof. W. T. Taggart, emeritus professor of chemistry in the University of Pennsylvania, on April 11, aged sixty-six years.

Prof. J. Thienemann, founder of the well-known ornithological station at Rossitten, who inaugurated the system of bird ringing, aged seventy-four years.

Prof. R. Verneau, honorary professor in the Muséum d'Histoire naturelle, professor of prehistoric anthropology in the Institut de Paléontologie humaine, on January 7, aged eighty-six years.

News and Views

Sir Leonard Rogers, K.C.S.I., C.I.E., F.R.S.

THE award by the Royal Society of Tropical Medicine of the Manson Medal to Sir Leonard Rogers will be felt by all to be a fitting recognition of outstanding contributions not only to tropical medicine in general, but particularly and almost uniquely to the practical application of therapeutic measures in the treatment of some of the most important major tropical diseases. As a result of his studies of biochemical and other changes in cholera, that most dread and dramatically fatal of all tropical diseases, Sir Leonard Rogers introduced the use of hypertonic saline injections at a time when such forms of treatment were little used. Further, to his untiring energy in directing attention to the necessity of taking active steps to combat the critical stage of the disease by this and other methods, many advances in the treatment of cholera owe their origin. The introduction by Rogers of antimony treatment of kala-azar in India, and his early efforts to improve the form of administration of the drug as well as to extend its application, was very largely responsible for later great advances in the treatment of this disease by organic antimonial preparations and for the remarkable developments which were later introduced for combating kala-azar on a large scale in India. By his insistence on the value of emetin in amœbic dysentery and by his introduction of the soluble salts of emetin, he very greatly stimulated the use of this valuable drug in the treatment of amœbic dysentery in all parts of the tropics. It was also his unflagging interest and insistence on the treatment of leprosy that led to so much attention being directed to the gynocardates, now widely used. Among contributions of a more academic type may be mentioned the discovery of the flagellate stage of the parasite of kala-azar, early researches on malaria and studies on the epidemiology of cholera. To the energy and initiative of Sir Leonard Rogers must also be ascribed the establishment of the Calcutta School of Tropical Medicine, the first large institution of the kind in the tropics.

Prof. A. Smithells and Salters' Institute Fellows

IN appreciation of advice and assistance rendered by Prof. Arthur Smithells while director of the Salters' Institute of Industrial Chemistry from 1922 until his retirement last year, a group of fellows of the Institute has made a presentation to him of a set of silver beakers suitably inscribed. Subscribers to this token of gratitude and affection were, with one or two exceptions, limited to those who held fellowships during Prof. Smithells' term of office as director. The Institute is maintained by the Salters' Company and has two main activities: training of selected graduates in applied chemistry, by means of fellowships, in Great Britain or abroad, and assistance by means of grants for fees and books to young men employed in chemical works who are attending evening classes. To the selection of the fellows, Prof. Smithells gave much thought and attention, and already many of them are filling important posts in chemical industry, this being the object for which the Company maintains the fellowships. He devoted also a very sympathetic consideration to those who were awarded grants, having regard to all the circumstances of the applicants, who are analogous to the apprentices of former days in whom the City companies took a living interest. About fifty of the former fellows who were selected during Prof. Smithells' time, as mentioned above, have now testified to their regard for the former director, and for the help he gave them in the important stage between the university and entrance into industry, by the recent presentation to him.

Disorderly Molecules and Refrigerating Engineering

SIR FRANK SMITH in his James Forrest Lecture to the Institution of Civil Engineers on May 3 pointed out that in recent years very low temperatures (that is, great reductions of molecular motion) have been attained, and the properties of materials at very low temperatures have been studied. The corresponding advance in engineering technique has resulted in the development of refrigerating engineering. The Joule-Thomson effect, whereby the work done in separating the molecules of a gas allowed to expand from a high pressure results in the gas being lowered in temperature, is used in many commercial processes for cooling gases, and in some cases for liquefying them. In order to obtain pure gases from air, the process of rectification is employed. The process depends on the fact that when equilibrium exists between a mixture of two liquids and the vapour it gives off, the composition of the vapour is always different from the composition of the liquid if the two liquids in the mixture have different boiling-points. For example, oxygen boils at 90° K. and nitrogen at 77° K., and when equilibrium exists between liquid air and the vapour above, the vapour contains about 7 per cent of oxygen and 93 per cent of nitrogen. The separation of oxygen and nitrogen by rectification is therefore carried out by allowing liquid air to drop slowly into liquid oxygen; the vapour given off by the latter condenses as it comes into contact with the drops, while part of the nitrogen in the drops simultaneously evaporates, and if the drops are sufficiently small and fall very slowly, all the nitrogen evaporates before the drops reach the vessel containing liquid oxygen. The process is continued, with the result that the gas becomes steadily richer in nitrogen. Other gases can also be extracted from the air by low-temperature separation.

Westinghouse Research Fellowships

THE Westinghouse Electric and Manufacturing Co., of Pittsburgh, Pennsylvania, has established ten 'post-doctorate' fellowships for research in physics, including chemical physics and physical metallurgy, to enable investigators to carry on their work at the Westinghouse Research Laboratories in East Pittsburgh. Five fellows have been appointed for 1938–39, and five more will be appointed in each succeeding year. The objects of the Company in establishing the fellowships are: "(1) To make a worth-while contribution to the development of the fundamental sciences on which modern industry is based. The Company feels that all research leading to a better understanding of the nature of matter and energy will ultimately prove valuable to technology even though its immediate field of application is not apparent. (2) To enable a group of able investigators to become familiar with the scientific problems confronting the electrical industry. It is felt that this contact will be of great value whether the men turn to industrial research or to academic work after completion of their fellowship period." Fellows will devote their entire time to work on their research projects, and will be under the general supervision of Dr. E. U. Condon, associate director for the programme of fundamental research. It is expected that they will also participate actively in the seminars and colloquia held at the Laboratories and in the neighbouring institutions of higher education. Appointments are made for a period of one year and a fellow is eligible for one reappointment for a like period. The salary is 2,400 dollars a year.

THE names of the first five Westinghouse Research Fellows, chosen from fifty applicants, are: Robert O. Haxby, University of Minnesota. Mr. Haxby has been a graduate student in physics for the last four years, and has participated actively in the nuclear physics research in the University of Minnesota. He will join the group which will carry on research in nuclear physics using the large high-voltage generator now being built in East Pittsburgh. John A. Hipple, Princeton University. Mr. Hipple has been a graduate student in physics at Princeton during the past four years, where he has worked with Prof. Walker Bleakney. He will design a large mass-spectrograph of high resolving power for studies in molecular structure in the Westinghouse Laboratories. Sidney Siegel, Columbia University. Dr. Siegel has carried out researches on elastic and magnetic properties of metals under the direction of Prof. S. L. Quimby. He hopes to develop methods of growing single crystals of pure metals and of alloys which show order-disorder transitions to study how the elastic properties of alloys depend on the arrangement of the atoms in the crystal lattice. W. E. Shoupp, University of Illinois. Dr. Shoupp is at present an instructor in physics at the University of Illinois, where he is actively engaged in studies on nuclear physics with the Illinois cyclotron. In addition to his work in nuclear physics, he has made several contributions to extreme ultra-violet spectroscopy as a collaborator of Prof. P. G. Kruger. At the Westinghouse Laboratories, he will continue studies in nuclear physics, working with Dr. W. H. Wells on the high-voltage generator. W. E. Stephens, California Institute of Technology. Mr. Stephens has done work in nuclear physics in the Kellogg Radiation Laboratory in Pasadena, where he studied the production of neutrons by bombarding boron and nitrogen with high-energy deuterons. He has also worked on the development of a new type of high-voltage discharge tube. In East Pittsburgh he will continue his researches on nuclear physics with the large generator at the Westinghouse Laboratories.

Bronze Age Hoard from Bognor

A bronze founder's hoard, which is dated at the early part of the first millennium B.C., has been brought to light at Flansham, near Bognor Regis. The find was made at a depth of about four feet at a point in Hoe Lane, a deep and ancient track now a lane, where it was joined by a new drive in course of construction. The objects discovered were distributed among several owners, but have been brought together again to be described by Mr. S. E. Winbolt in *The Times* of May 9. With six bronze implements were twenty-two lumps of copper, weighing 14 lb. Some round pieces of copper indicate a diameter of six inches for the complete cake, which would appear to have been cast in a crucible with a slightly concave bottom. This hoard is evidently the stock-in-trade of a bronze founder, such as has been discovered not infrequently in Britain. Mr. Winbolt recalls that a similar hoard was found in the course of road construction at Bognor some twelve years ago. The implements found with the copper are two socketed and looped celts, with square-mouthed socket openings, cast with a core, two socketed gouges, the top of a V-type sword with rivet holes, and the side of the top of a carp's tongue sword with a very sharp edge, which is compared with those of the Addington (Kent) and Beachy Head deposits. All may be dated at about 1000–750 B.C., and are probably a native product, though showing the influence of Spain and north-west France. It is to be noted that, as usual, there are no traces of tin with the copper. It is suggested that this, as well as the other and slightly earlier Bognor hoard, may have been abandoned or temporarily hidden, on account of the difficulties of a journey arising from the marshy character of the ground in this neighbourhood at the period.

By-product Coking

ON March 17, G. W. J. Bradley, in a paper presented to the Institute of Fuel, briefly reviewed the history of the coking industry from its inception at the beginning of the eighteenth century to the present day. This development has gradually culminated into a tendency for the industry to split into two sections, the section connected with iron and steel works and regarded as an auxiliary part of steel works technique and the section situated at the collieries. During the years 1934–37 orders have been placed by British steelworks for plants to

carbonize approximately six and a half million tons of coal per year. This figure is equivalent to one third of the total carbonizing capacity of the industry. Naturally this prodigious increase in the number and capacity of plants provided by steelworks has deprived colliery-owned coke ovens of a large proportion of the market for furnace coke. Nevertheless, there is no cessation of coking at the collieries, as is apparent from the fact that, during the period 1934–37, 664 coke ovens were ordered by British collieries. So far as future developments of the industry are concerned, much depends upon the attitude adopted by coal owners and on the education of popular opinion towards a correct understanding of the principles involved. Carbonized fuel, whether solid or gaseous, is eminently suitable for domestic heating. The coal trade must be brought to realize this and steps should be taken to compensate for the inevitable loss of revenue which will follow the disappearance of raw coal from the domestic fuel market. Instead of fighting to retain raw coal in this market by raising the price of coal to those who make smokeless fuel, the coal trade should develop a widespread scheme of collaboration with producers of carbonized fuel. By-product coking is as fundamentally important an industry to the nation as a whole as is the coal industry, and as such it should be developed both technically and commercially with the greatest possible foresight.

A Bridge Without Bolts or Rivets

IT is stated in *Electric Welding* of February, a bi-monthly magazine published by the Quasi-Arc Co., Ltd., of London, that the London Passenger Transport Board has placed the contract for the building of a new bridge to carry the Hammersmith and City Railway over Ladbroke Grove, just outside Ladbroke Grove Station. The new bridge is to be of all-welded construction, and will be the first of its type and size in Great Britain. The present bridge has been in service for seventy years. The advantages of having a bridge without bolts and rivets are: the reduction of weight by one fifth, a substantial reduction of cost and much less noise during construction. The new bridge will be 60 ft. long; it will be built on three girders instead of two, and there will be a ballasted track instead of a timber track. These improvements will give much quieter running and also more steadiness and strength. It will be erected on trestles beside the present bridge, and early one Sunday morning the old structure will be rolled away and the new one rolled into place. Dr. Schaper, chief engineer of the German State Railways, stated in a paper last May read before a joint meeting of the Institution of Civil Engineers and the Institution of Structural Engineers that already at that time there were 150 all-welded railway bridges in service on the Reichsbahn up to spans of 177·2 ft. At least as many all-welded bridges have been constructed in connexion with the new German arterial motor roads with spans nearly 100 ft. long. In Belgium nearly fifty welded bridges of the Vierendeel type up to spans of 295 ft. have been constructed over the Albert Canal. It seems certain that, in the future, welding will play an increasingly large part in the technique of construction.

Safeguarding London's Water Supply

MUCH information of considerable interest to the biologist and hygienist, chemist and bacteriologist is included in the thirty-first annual report of the Metropolitan Water Board, which contains the results of the chemical and bacteriological examinations of London waters during 1936, compiled by the Director of Water Examination, Lieut.-Colonel Harold (London: P. S. King and Son, Ltd. 10*s.* 6*d.*). The daily supply of water in 1936 averaged 287·7 million gallons, yielding 96·5 per cent of samples regarded as being of first-class quality. In the laboratories, 35,075 samples were examined in order to keep a watch upon the purity of the supply. In the Bacteriological Section investigations were conducted on the routine methods for the isolation and identification of *Bacillus coli* and allied bacteria, and on the isolation of *B. paratyphosus* B and of streptococci. Turbidity estimations, and the action on metals of tap-water before and after softening, have been investigated in the Chemical Section. Much trouble is sometimes caused in the reservoirs by the growth of Algæ, and the relation of chemical composition of the water to problems of algal production is one of the subjects investigated in the Biological Section. An interesting find was the blind well shrimp, *Niphargus aquilex*, which is naturally a subterranean species, but which has established itself in the filter beds at the Kempton Park Works. The report concludes with the tables containing the chief analytical results obtained.

Transport of Tropical Fruits and Vegetables

THE Imperial College of Tropical Agriculture, Trinidad, publishes, as Memoir No. 7, November 1937, a very valuable summary of the methods now available to bring the produce of the tropics to the English markets, which goes far to explain the greater variety and interest of the window display of the greengrocer and the fruiterer throughout all the months of the year. Some 150 names of vegetables and fruits are listed—for many of these, as citrons, bananas and pineapples there is already much experience gathered and a long bibliography to cite, while others like mangoes and the papaw attract attention as household words of the tropics from which much is to be hoped if distance and time can be conquered; but so far their transport is evidently in the experimental stage. Many of the fruits and vegetables enumerated have been but names, if that, to dwellers in the temperate zones so far; the litchi has arrived in much larger quantities lately and been much appreciated; the mangosteen and the langsat are still awaited. This list raises many hopes, and this concise summary of practical experience should prove of material value in enabling importers and transporters to learn how much has already been achieved and what possibilities there are for the future. Copies of this publication may be obtained (price 4*s.*, British; 4*s.* 6*d.*, foreign) on application to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

Marine Biology in Ceylon

THE administration report of the Marine Biologist (A. H. Malpas) for the year 1936 (Part 4, Education and Art (G), Ceylon, 1937) states that the Advisory Committee of the Colonial Development Fund has recommended the offer of a grant of Rs. 87,500, from the fund, to meet the cost of the erection and equipment of a fisheries research station and hatchery in accordance with the scheme approved by the Ministry of Local Administration and submitted to the Secretary of State in 1935. Provision of Rs. 175,000 has been included in the Schedule to the Public Works Loan Ordinance to meet the cost of erection and equipment of an aquarium to complete the scheme. The aquarium is a necessary adjunct to the research station in that its large aquaria tanks will provide essential facilities for investigation and research into the bionomics of food fishes and other marine and freshwater animals of economic importance. Besides this it is proposed to establish fish culture ponds within easy reach of Colombo and to purchase a demonstration fishing vessel—a Yorkshire motor coble with auxiliary sail. The department's research vessel *Nautilus* is to be replaced by a somewhat smaller teak-built vessel with diesel engine, which will be equipped with various types of modern fishing gear and essential research apparatus. This, in conjunction with the coble, will undertake a comprehensive scheme of fisheries research in the coastal waters.

Electron Optics

IN the issue of the *Revue générale des Sciences* of February 28, M. R. Fritz, of the University of Besançon, gives a short review of the progress made in the first ten years of its existence of this new branch of optics, which he also denominates electron physics. He starts from the fact that electrons radiating from a point may by means of a uniform magnetic field be made to pass through a second point on the line of the field on which they originated. The analogy with the action of a converging lens on light leads to the term 'magnetic electron lens'. An 'electric lens' may be constructed from three thin parallel conducting sheets with equal circular holes through them, if the outer sheets are at the same and the middle one at a different potential. With these elements he shows how apparatus has been constructed which reproduces the action of microscopes and spectrographs, and he explains how electron optics has rendered the theory of the action of older apparatus such as valves and Braun tubes clearer, and has specified the functions of parts originally introduced empirically. The newer apparatus dealt with is connected mainly with the utilization of secondary electron radiation in television.

The Rockefeller Foundation

THE annual report of the Rockefeller Foundation for 1936 contains a review by the president, Mr. Raymond B. Fosdick, the reports of the secretary and the treasurer, and detailed reports of the work of the divisions. The International Health Division has continued investigations on yellow fever, malaria, tuberculosis and other diseases, and has now included scarlet fever and influenza among its inquiries; it has also been largely instrumental in the production of an effective method of preventive vaccination against yellow fever. In medicine, attention has been mainly concentrated upon mental and nervous diseases, and the Foundation has supported studies in endocrinology, genetics, and physiology, and the application of chemical and physical methods and mathematical analysis to biological problems. In the humanities, appropriations have been made, among others, for the development of radio programmes of cultural and educational value, and for education in China. Fellowships to the number of 504, spread over a wide field of knowledge, have been directly financed by the Foundation, and much aid has been given to exiled German scholars.

Land Utilization in Tasmania

As an example of the application of scientific assessment of a country's resources, the survey of the "Land Utilization Regions of Tasmania" by Mr. A. G. Lowndes and Mr. W. H. Maze is important (University of Sydney Publications in Geography, 1937. Price 2*s.* 6*d.*). The authors recognize seven qualities of land values, some of them with subdivisions. These were determined during the summer of 1935–36, and the resultant map may be regarded as an agricultural census of that year with indications of the areas in which further development is possible. The survey shows that climate and topography sets definite limits to possible utilization. The whole of the west and south, with a few local exceptions in the interests of mining, is mountainous and undeveloped and offers little scope for settlement; some is deforested and has lost its topsoil. On the other hand, the north and east afford great scope for settlement, especially as regards dairying, grazing and horticulture. A number of distributional maps add to the value of the survey.

American Literature on Social and Political Affairs

A FURTHER list of inexpensive pamphlets on social, economic, political and international affairs, revised to February 1937, has been issued by the Office of Education, U.S. Department of the Interior, under the title "Public Affairs Pamphlets" (*Bulletin* No. 3, 1937). The compilation, which is limited to material published in the United States, was prepared primarily to meet the needs of the ten public forum demonstrations organizing programmes of public discussion. It is based on information supplied by publishers and is limited to brief pamphlets costing not more than 50 cents. No attempt is made to evaluate the contents of the pamphlets listed, although a brief statement of the contents is given in amplification of the title. Although not a comprehensive list, the indexing and arrangement of this publication according to publishers and authors as well as by subjects, make it a very useful guide to this type of literature.

American School Buildings

SCHOOL building problems in the United States have assumed such importance that a National Advisory Council has been organized under the auspices of the Office of Education, Washington, at the request of State superintendents and commissioners of education. At the Council's first conference it was determined to begin with a study of the "functional planning of elementary school buildings", and a report on this subject has been published by the United States Government Printing Office (pp. 84, 25 cents). The report, which is illustrated with numerous photographs, floor plans and charts, shows, among other things, that the elementary school curriculum is changing in ways which radically affect the planning of buildings, and that costs depend largely on the extent to which school work is organized so as to get a simultaneous, balanced use of all facilities. Taxpayers often protest against the excessive cost of providing for the numerous additions to the traditional "three Rs" demanded by the modern elementary school curriculum: music, art, science, crafts, training for leisure, physical culture, play, etc. The report claims that, by the adoption of the so-called 'platoon' system, accommodation for all these activities can be provided without extra cost. Under this system, the classes are all duplicated, and while one set occupies the 'home rooms' the other set uses the rooms set apart for special activities, and vice versa.

Reading Administratively

A GENERAL administration course of reading has been drawn up by Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1., designed to introduce the idea of reading administratively. While the course is intended primarily for those holding administrative positions, it has a cultural value and aims at serving as a practical form of education for citizenship, including membership, not only of a country or nation but also of businesses, services and institutions. It is intended to provide standards for criticism, imitation and inspiration. Utilizing material of administrative interest to be found in general as well as specialized works and including fiction and poetry, the course should give a general insight into how man governs in different fields and at different levels in the complex hierarchies of administrative control. While there is no time limit it is suggested that, reading eight hours a week, the recommended literature could be studied adequately in six to nine months, after which the practical reader will begin to specialize. Tuitional assistance is given by post in the form of instruction regarding the meaning and principles of administration and what to look for, more detailed treatment of examples, criticism of readers' notes and the like.

Aquarist and Pond-keeper

WE are glad to note that the *Aquarist and Pond-keeper* is to be published monthly in future instead of every two months. Ever since it was founded by the late Mr. A. E. Hodge, amateur aquarists have had cause to be grateful for its helpful articles on the many aspects of their hobby. These articles have, on the whole, reached a high standard without being too technical. The illustrations, too, have generally been good, some of the photographs of living fishes taken by Mr. W. S. Pitt, for example, deserving special mention. There have, in addition, been regular articles on reptiles and amphibians and their management in vivaria; these must have had considerable effect in popularizing the keeping of such creatures as pets. A section giving notes and news from the big public aquaria is a welcome feature newly introduced. We wish the *Aquarist and Pond-keeper* a long and useful life as a monthly publication.

Campaign against Cancer in Algeria

THE recent establishment of an anti-cancer organization in Algeria is of interest, in view of the particular conditions of race, custom, and climate existing in that country. Already at Algiers, attached to the surgical clinic of the hospital, a centre for treatment and investigation of cancer is in existence, with radiological equipment including a 300 kv. radiotherapeutic installation, and with the necessary laboratory services for cancer research. It is also proposed to install a larger quantity of radium for teletherapy, to set up secondary centres in the country, and to launch a scheme of propaganda against cancer.

Teaching of Technical Optics

IN the article under this title in NATURE of April 9, p. 654, in the reference made to the examinations held by the British Optical Association and the Spectacle Makers Company and to the schools recognized by the former body, it was stated that, outside London and Manchester, the attendance is "of the order of a dozen students in the session". The Principal of the Bradford Technical College writes to point out that the number of evening students taking the technical optics course at the College has in the last eight years averaged upwards of forty students, and that fifteen students have attended the full-time day course in the last five years.

Co-operation between Great Britain and France

A CORRESPONDENT, referring to principles of comity amongst nations, writes: "René A. F. de Réaumur (1683-1757), the French physicist, was elected a fellow of the Royal Society in 1738, during the presidency of Sir Hans Sloane. Later, on May 4, 1745, Réaumur, writing to Martin Folkes, then president, said: 'I heartily wish there was in the world as strong a moral attractive power as there is a natural one that might dispose our two nations particularly to seek to unite by mutual acts of friendship and goodwill.' "

Agricultural Scholarships

THE Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland invite applications for agricultural scholarships from students who propose to follow the career of agricultural

organizer or instructor or lecturer in agriculture (including horticulture, dairying and poultry-husbandry). The object of the scholarships, of which not more than four will be awarded annually, is to broaden the agricultural knowledge and experience of students and so to qualify them for the position of agricultural organizer, instructor or lecturer. The value of the scholarships will not exceed £200 together with an allowance for approved fees and travelling expenses. The period of the scholarships is normally one year and commences on October 1. Further information can be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Announcements

THE U.S. National Academy of Sciences, Washington, has awarded the Agassiz Medal for Oceanography to Dr. E. J. Allen, who was for forty-two years director of the Plymouth Laboratory of the Marine Biological Association. The Murray Fund, which was established for the award of the medal, was founded by Sir John Murray in 1911 to commemorate the oceanographical work of Alexander Agassiz. The medal was received on behalf of Dr. Allen by Mr. L. McCormick-Goodheart of the British Embassy at Washington, at a dinner held by the Academy on April 26.

THE Earl of Radnor has been appointed chairman of the Committee of Management of the Rothamsted Experimental Station. This appointment is in accordance with the long-established usage at Rothamsted of choosing a chairman from among those who are intimately associated with the land; previous chairmen have included such well-known agriculturists as Lord Clinton, Sir Merrik Burrell, Lord Bledisloe and others. Lord Radnor's active interest in rural development and his wide knowledge of the many intricate problems of modern agriculture will undoubtedly prove of great value to the Station.

THE Medical Research Council has appointed Dr. Karl Stern to the Kathleen Schlesinger research fellowship for the year 1938–39. This fellowship is provided from a fund established by the late Mr. Eugen M. Schlesinger and Mrs. Schlesinger in memory of their daughter: it is given for investigations of cysts of the brain or allied conditions, and is ordinarily tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London.

THE annual visitation of the Fuel Research Station, East Greenwich, will be held on Tuesday, May 31 at 2–6 p.m.

A COURSE of thirty lectures on genetics and cytology and on related studies in pomology and plant biochemistry, for research and post-graduate students and university teachers, will be given at the John Innes Horticultural Institution, Mostyn Road, Merton, London, S.W.19, on July 11–23. Inquiries should be addressed to the Registrar at the Institution.

THE next award of the Swiney Prize, which is decided by a joint committee of the Society of Arts and the Royal College of Physicians, will be made in January 1939. The prize, consisting of a cup and the sum of £100, is offered alternately for the best published work on medical and general jurisprudence, and this time is offered for medical jurisprudence. Applications should be made to the Secretary, Royal Society of Arts, John Street, W.C.2, before November 30.

PROF. HERMANN STIEVE has been nominated president of the International Committee for the Improvement and Unification of Anatomical Terms.

PROF. MARTIN KIRSCHNER, director of the surgical clinic at Heidelberg, has been nominated a member of the Kaiser Leopold Caroline German Academy of Natural Sciences at Halle.

DR. ALEXANDER KOENIG, professor of ornithology at Bonn, has been awarded the shield of nobility of the German Reich, and Dr. Gottlieb Linck, professor of mineralogy and geology at Jena, has received the Goethe Medal for art and science.

THE foundation of a Ministry of Health in Japan has been indefinitely postponed owing to the war with China.

THE third Frankfort Conference for Collaboration between Medicine and Natural Science, organized by Profs. R. Otis, K. Felix and F. Laibach, will be held at Frankfort on June 2–3, when the subject for discussion will be the chemistry and physiology of albumin. Further information can be obtained from Universitäts-Institut, Weyerstrasse 3, Frankfurt-a.-M.

THE first Pan-American Congress of Endocrinology, which is also the first congress on this subject to be held, will take place at Rio de Janeiro on July 17–23 under the presidency of Prof. Aloysio de Castro. There will be four sections devoted respectively to the experimental, clinical, surgical and medico-social aspects of endocrinology. Further information can be obtained from Academia Nacional de Medicina, Avenida Augusto Severo 4, Rio de Janeiro, Brazil.

The seventh International Congress of Genetics will be held in Edinburgh in 1939 under the presidency of Prof. N. I. Vavilov, vice-president of the Lenin Academy of Agricultural Science and director of the Institute of Plant Industry, Leningrad, and of the Institute of Genetics of the U.S.S.R. Academy of Sciences. The dates of the Congress will probably be August 23–30. Further information can be obtained from Prof. F. A. E. Crew, Institute of Animal Genetics, West Mains Road, Edinburgh, 9.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 879.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cytochrome *a* and Cytochrome Oxidase

A HEART muscle preparation obtained by a method previously described[1] contains several dehydrogenases, a very powerful cytochrome oxidase and the three components (*a*, *b*, and *c*) of cytochrome. This material contains a high concentration of cytochrome *a* and is therefore very suitable for the study of this component.

Spectroscopic examination of this preparation shows only a very diffuse absorption with two or three narrow and scarcely perceptible bands. Neither the removal of oxygen by boiling the preparation in a vacuum nor the addition of potassium cyanide affects this absorption spectrum. Cytochrome remains in the oxidized state, which shows that the preparation is completely devoid of reducing substances and metabolites.

On addition of sodium hyposulphite, the absorption spectrum of reduced cytochrome rapidly appears; showing an exceptionally strong band *a* occupying its usual position at about 605 mμ. Succinic acid added to the preparation also reduces cytochrome, but not so completely as does sodium hyposulphite.

On passing carbon monoxide through the reduced preparation, the bands *b* and *c* remain unmodified, while the band *a* undergoes a very marked change. The short-wave portion of this band becomes pale and spreads towards the band *b*, partly obliterating the clear space between these two bands. This pale portion of the band *a* shows, moreover, a slight reinforcement at about 593 mμ. It looks as if a portion of component *a* combines with carbon monoxide forming a derivative which has its absorption band less defined than the original band *a* and lying at about 593 mμ.

The addition of potassium cyanide to a preparation containing sodium succinate does not affect the absorption spectrum of the reduced cytochrome. On shaking such a preparation with air, only a small portion of cytochrome *a* undergoes oxidation, which is indicated by the band *a* becoming slightly narrower. If, however, this preparation is now treated with carbon monoxide, the carbon monoxide compound does not appear and the band *a* remains unchanged. Only after long standing does the band *a* undergo a characteristic modification due to the appearance of the carbon monoxide compound.

This experiment seems to show that potassium cyanide combines with the trivalent iron of the hæmatin, which inhibits to some extent its reduction by the succinic system and the formation of a compound with carbon monoxide.

On the other hand, if potassium cyanide is added to the preparation when its cytochrome is completely reduced by sodium hyposulphite, the band *a* undergoes a change somewhat similar to that obtained with carbon monoxide, which indicates that the cyanide combines also with the divalent iron of this hæmatin.

Sodium azide added to the reduced preparation does not affect its absorption spectrum. Azide does not prevent the formation of the carbon monoxide compound, which is, however, somewhat delayed owing to the slight inhibitory action of azide on the reduction of all the components of cytochrome by the succinic system.

The effect of carbon monoxide on the absorption band of cytochrome *a* is shown not only by heart muscle preparations but also by preparations obtained from skeletal muscles of mammals, pectoral muscles of the pigeon, fresh thoracic muscles of bees and wasps, and suspensions of living *Bacillus subtilis* or of baker's yeast. In the last two cases, however, owing to the lower intensity of the band *a*, the effect of carbon monoxide, although quite definite, is less marked than in muscle preparations.

All these observations seem to show that the band *a* of cytochrome belongs to two slightly different hæmochromogen compounds having the same hæm nucleus. One of these compounds (*a*) is not autoxidizable and does not combine with potassium cyanide or carbon monoxide, while the other (a_3) is autoxidizable and combines with both. In this respect it resembles the components a_1 and a_2 which occur only when component *a* is missing[2].

The carbon monoxide compound of this component has its absorption band at 593 mμ, that is, in the position occupied by the band in the photochemical absorption spectrum obtained by Warburg and his co-workers.

That this compound may be responsible for the photochemical absorption spectrum is, moreover, supported by the fact that the carbon monoxide inhibition of respiration is found to be light sensitive only in the organisms showing the presence of cytochrome *a* (605 mμ) or of its derivative a_1 (583 mμ).

At first sight, these results seem to suggest that the autoxidizable component (a_3) of cytochrome *a* is cytochrome oxidase itself. Several facts, however, militate against this view, namely: (1) the existence of cytochrome oxidase in cells devoid of cytochrome *a*, (2) the oxidation of the three components of cytochrome in air, while the component a_3 remains still combined with carbon monoxide, and (3) the oxidation of the carbon monoxide derivative of this component in presence of sodium azide while the other components remain reduced.

The component a_3, although it may be responsible for the photochemical absorption spectrum, cannot therefore be identified with the oxidase, and the problem as to the nature of this enzyme remains open for further investigation.

The fact that the enzyme is so intimately bound to the insoluble material of the cell makes it extremely difficult to study this problem by the ordinary methods of purification and isolation. In the circumstances, every possibility should be carefully examined and tested by suitable experimental methods, and of these possibilities the following three deserve special consideration:

(1) The enzyme may yet be a hæmatin-protein compound similar to cytochrome *a*, or even a protein sharing with cytochrome *a* its hæmatin nucleus. Owing, however, to its possible low concentration, it may still be spectroscopically invisible even in our strong enzyme preparations.

(2) The enzyme may be an iron-protein compound devoid of porphyrin and resembling some other iron-protein compounds known to occur in tissues.

(3) The enzyme may be a copper-protein compound. Although there is no direct evidence yet in favour of this supposition, it is nevertheless strongly supported by the following considerations:

(*a*) Copper salts are so far the only known simple metal salts which rapidly oxidize all the components of cytochrome. (*b*) The addition of copper to nutrient media for yeast and to copper deficient diet for rats produces not only an increase in the concentration of cytochrome *a* in the cells of these organisms but also greatly intensifies their indophenol reaction[3,4,5]. (*c*) There is a rough parallelism between the intensity of the indophenol reaction of various tissue preparations measured in terms of Q_{O_2} (at 39° C. and *p*H 7·3 in presence of excess of cytochrome *c* and of *p*-phenylenediamine) and their copper contents. (*d*) The only other known intra-cellular enzyme which has many properties in common with cytochrome oxidase is the polyphenol oxidase of plants. This enzyme, as was recently demonstrated[6,7], is a copper-protein compound. (*e*) Moreover, the inhibition by carbon monoxide of cytochrome oxidase in cells devoid of cytochrome *a* resembles that of polyphenol oxidase in being insensitive to light.

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April 13.

[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **125**, 171 (1938).
[2] Keilin, D., NATURE, **133**, 290 (1934).
[3] Elvehjem, C. A., *J. Biol. Chem.*, **90**, 111 (1931).
[4] Cohen, E., and Elvehjem, C. A., *J. Biol. Chem.*, **107** 97 (1934).
[5] Yoshikawa, H., *J. Biochem.* (Japan), **25**, 627 (193.).
[6] Kubowitz, F., *Biochem. Z.*, **124**, 10 (1937).
[7] Keilin, D., and Mann, T., *Proc. Roy. Soc.*, B, **125**, 187 (1938).

Preparation of Radio-Element $^{32}_{15}$P in Weighable Quantity by Means of an Electric Field

In order to obtain large quantities of radio-phosphorus for certain experiments, we have attempted to find a method of concentrating the radio-element by means of an electric field. Some attempts of this kind have already been made with success by J. W. J. Fay and F. A. Paneth on bromine, iodine and arsenic[1].

The radiophosphorus was produced by the neutrons from a source of 120 mgm. of radium + beryllium. Very pure carbon disulphide, prepared by shaking for two days with corrosive sublimate and distillation, was placed in a tall glass flask of about 1 litre capacity; two brass rods with two rectangular brass electrodes soldered at their extremities pass through the stopper; the field applied was of 70 volts per cm. After nine days of irradiation we examined the electrodes with a Geiger-Müller counter and we measured, on the four faces of the electrodes, the following activities:

anode		cathode	
inside	outside	inside	outside
827	367	427	191

that is, a total of 1,800 kicks per minute. These figures show that the activity of the anode was about double that of the cathode.

The carbon disulphide was submitted to the chemical concentration described by O. Chievitz and G. Hevesy[2]. The result showed that during this first attempt a large part of the radiophosphorus escaped concentration. In order to be sure that this was really $^{32}_{15}$P, we followed the activity of the electrode and the resulting products of chemical concentration for 50 days, and we observed that the activities decreased with a period of 14–15 days, which is that of $^{32}_{15}$P.

Cleaning the electrode with emery paper removes all its activity but boiling it in distillated water does not affect its activity; though this latter entirely disappears if one puts the electrode in dilute nitric acid for one minute; in this case, practically all the activity is found again in the residue after evaporation of the acid.

The appearance of the electrodes after irradiation was totally changed, for they were darkened. Experiments done under the same conditions as above, but without neutrons, left the electrodes unaffected in appearance. From this we can conclude that the visible deposit is due to radiophosphorus. It is very probable that the $^{32}_{15}$P formed was combined with the copper or another element of the brass and formed a phosphide of this element.

When repeating the experiment but dissolving a little yellow phosphorus in carbon disulphide and without any irradiation we obtained the same alteration of the brass. In other attempts similar to these, we used pure copper electrodes; we observed that the copper was altered and covered with a black layer. A qualitative chemical analysis showed that this layer contained phosphorus and copper: so there is very probably formation of phosphide of copper. This determined us to use pure copper electrodes in the following experiments.

These second attempts were conducted in a similar way. The irradiation lasted nine days; the field was 70 volts per cm. during the first days and 90 volts per cm. during the last three. The electrodes were covered with a black deposit, and the anode alone showed an activity of 1,800 kicks per minute. The electrode weighed before and after the irradiation showed an increase of 3·7 mgm. The remaining carbon disulphide submitted to the chemical concentration had an activity so insignificant that we may conclude that practically all the activity has been collected on the electrodes.

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April 5.

[1] Fay, J. W. J., and Paneth, F. A., *J. Chem. Soc.*, 384 (1936).
[2] Chievitz, O., and Hevesy, G., *Det Kgl. Danske Vid. Selsk.*, Biol. Medd., **13**, 9 (1937).

Elimination of the Mosaic Crystal Imperfection Effect on the Width of X-Lines

ON the basis of results obtained by means of different spectroscopic methods, I wish to show that the highest attainable resolving power does not always correspond to the perfection of the crystal measured by means of the double-crystal spectrometer. High resolving power can be attained both with imperfect (mosaic) crystals and with perfect ones.

For example, in the case of crystals of sodium chloride, for the reflecting width w_ε the minimum value of 87″ has been found experimentally[1]. According to this value, the width W of the copper $K\alpha_1$ line should correspond at least to 88″ (if the validity of the Gauss equation[2], $W = \sqrt{w_\varepsilon^2 + D^2 w_\lambda^2}$, is assumed). According to Hoyt's equation[3], $W = w_\varepsilon + Dw_\lambda$, the value of W for the copper $K\alpha_1$ line should amount to at least 102″. It will be shown here that these relations cannot be used generally.

With Prof. Dolejšek[4], I have obtained by means of the symmetrical spectrographic arrangement, in which the distance slit to crystal equals the distance crystal to photographic plate, with a crystal of sodium chloride an uncorrected value of $W = 15''$ for the true width of the copper $K\alpha_1$ line measured at half maximum of the rocking curve, which corresponds to 0·41 X.U. A similar result was obtained with the lines of molybdenum, where $W = 11''$, that is, 0·30 X.U.

This indicates that the imperfection of the sodium chloride crystals cannot in this case have any influence on the width of the lines as given by the equations referred to above. It is further evident that the values of the width of the lines obtained by us correspond to the true width of the lines of the above-mentioned elements determined by means of the double-crystal spectrometer.

These facts can be explained if two kinds of imperfection of the crystal are assumed. The first kind of imperfection is caused by the mosaic structure of the crystal, which will be designated by $\Delta\sigma$; the second one consists in an irregular arrangement of the atomic planes in the crystal, $\Delta\delta$, or in some other factors. However, it can be shown (unpublished work) when using the symmetrical spectrographic arrangement that reflection on mosaic crystals leads to an angular broadening of the line towards the short wave-lengths:

$$w_\sigma = (\Delta\sigma)^2 \cot\varphi,$$

where φ is the angle of the deflection. The broadening of the lines calculated by means of the formula given above, which holds for the crystal of sodium chloride, can be neglected for X-rays of medium wave-length. When, however, the photographic plate is shifted in the direction towards or from the crystal, so that the distances slit to crystal and crystal to photographic plate are made unequal, a broadening of the line due to the mosaic structure of the crystal is produced. From such a broadening of the line at different distances of the plate from the crystal, the value of w_ε for the crystal of sodium chloride was determined, which gave a value of about 100″. If this value is substituted in the above formula, the angular broadening of the lines w_σ is 0·2″ (which corresponds to about 2 per cent of the true width of the lines copper $K\alpha_1$) at half maximum of the rocking curve. This broadening of the line $\Delta\lambda_\sigma = 0{\cdot}008$ X.U. lies below the limit of accuracy attainable by the most accurate methods.

It is thus obvious that crystals with imperfect mosaic structure allow us to get the extreme resolving power when the symmetrical arrangement is used, since the broadening of the lines due to the mosaic structure is negligible.

The second kind of imperfection of the crystal (which cannot be eliminated by means of the symmetrical arrangement) is, as can be seen from our results given above, inappreciable. These facts are in agreement with the findings of Ewald and Renninger[5], which have shown that the small planes of the crystal of sodium chlorine reflect according to the perfect structure, but not according to the mosaic. Thus the influence of $\Delta\sigma$ is approximately the same as in the case of perfect crystals, that is, in the absence of the mosaic structure. According to these results, new methods for measurements of the imperfection of crystals can be worked out; further, the equation for the physical resolving power of crystals, as given by Allison[6],

$$\frac{\lambda}{\Delta\lambda} = \frac{\tan\varphi}{w_\varepsilon},$$

must be modified, putting in instead of w_ε the function of w_σ and w_δ.

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March 27.

[1] Kirkpatrick and Ross, P. A., *Phys. Rev.*, **43**, 596 (1933).
[2] Ehrenberg, W., and Mark, H., *Z. Phys.*, **42**, 807 (1927). Schwarzschild, M. M., *Phys. Rev.*, **32**, 162 (1928).
[3] Hoyt, A., *Phys. Rev.*, **40**, 477 (1932).
[4] Bačkovský, J. M., and Dolejšek, V., *Č. J. Mat. Fys.* **67**, No. 3 (1938).
[5] Ewald, P. P., and Renninger, M., Int. Conf. on Phys., London **2**, 57 (1935).
[6] Allison, S. K., *Phys. Rev.*, **33**, 207 (1931).

Formation of Negative Ions at Surfaces

ARNOT has described experiments[1] which he has interpreted as showing that a positive ion striking a surface can be converted into a negative ion by capture of two electrons. The negative ions drawn off may have energies in excess of that imparted to them in the accelerating electric fields. Some of this work was not in agreement with other results which one of us had obtained for negative ions, and we have therefore repeated and extended it.

Using an apparatus somewhat similar to Arnot's, but constructed entirely in a blown pyrex tube which could be degassed at high temperature, we were unable to find the negative ion of mercury once the apparatus was thoroughly clean, although initially, whilst a certain amount of impurity was present, a negative ion with approximately the mass of the Hg^- ion was found, in agreement with earlier work by Stille[2]. However, bombardment of metal surfaces in the ionization chamber, by presumably mainly Hg^+, did produce several light negative ions ($C_2H_2^-$, CO^-, etc.), and these possessed excess energy. Subsidiary experiments indicated that this energy did not come from electrical oscillations within the tube; in particular, negative ions with excess energy could be drawn off normally from a flat plate bombarded normally with the positive ions.

These new experiments raised the question of the uniqueness of the mechanism of negative ion formation proposed by Arnot; they seemed rather to

support the idea that a major cause of the production of negative ions might be sputtering of persistently occluded electronegative films by bombardment with positive ions. We have now been able to show that the latter process does occur, by using a double mass-spectrograph.

Positive ions were drawn from a mercury discharge, and after magnetic sorting were projected on to a nickel-chrome disk. Negative ions again appeared and were identified by a second magnetic analysis. It was found that Hg^+ and Hg^{++} both produced a spectrum of light negative ions, with maximum peak currents of the order of 10^{-11} amp. Again Hg^- was not detected, although the Compton electrometer used could have measured currents of the order of 10^{-16} amp. A complex positive ion beam of mass about 28 (presumably mainly CO^+) also gave a negative ion beam of about the same mass. In all cases the yield of negative ions was proportional to the bombarding positive ion current. The light negative ions of mass about 28 produced by bombardment with Hg^+ were found again to have excess energies; the other beams have not yet been studied in this way.

The fact that we did not obtain Hg^- is not necessarily incompatible with Arnot's observation of it. We cannot exclude the possibility that differences in surface structure may be responsible for the discrepancy. A question of greater moment is whether in fact any process other than sputtering occurs.

Experiments similar to ours, except that magnetic sorting of the positive ions was not employed, were apparently done by J. S. Thompson[3] in 1931, but, so far as we know, details of this work have never been published.

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R. PRESS.

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April 5.

[1] Arnot and Milligan, *Proc. Roy. Soc.*, A, **156**, 538 (1936). Arnot, *Proc. Roy. Soc.*, A, **158**, 137 (1937). Arnot, *Proc. Roy. Soc.*, A, **158**, 157 (1937).
[2] Stille, *Ann. Phys.*, **17**, 635 (1933).
[3] Thompson, J. S., *Phys. Rev.*, **38**, 1389 L. (1931).

Response of Barrier-Layer Cells to X-Rays of Long Wave-Length

IN 1931 Selenyi and Lange[1] reported that they had obtained photo-currents from barrier-layer cells exposed to X-rays of short wave-length. Later, Gleason[2] studied the effect of X-rays on a large number of cells, and Scharf and Weinbaum[3] made a thorough investigation on this subject.

However, these investigations were all made with hard X-rays; nothing has so far been known of the response of barrier-layer cells to X-rays of long wave-length. I therefore undertook to study this question. Naturally, in this wave-length region such an investigation has to be carried out in a vacuum, and a special apparatus was built for this purpose. The intensity of the radiation falling on the barrier-layer cell could be varied by changing the distance between the focus and the cell. Visible light was completely screened off by two aluminium foils, each of them 0·5 μ thick. For the preliminary investigations two commercial selenium cells of different origin were used. Both these cells had a protective foil of celluloid. This foil together with the two aluminium foils brought the long wave-length boundary of the effective radiation somewhat below 20 A. The short wave-length boundary was given by the voltage of the X-ray tube.

The data in the accompanying table may give a conception of the sensitivity of the cells in this wave-length region. A rough calculation gave the order of magnitude of the photo-electromotive forces to 10^{-4} volt. It has to be observed that in the first case the radiation contained the whole *M*-series of tungsten, and in the second that part of it which contains the strongest lines, but in the last case none of it was present.

Current through the X-ray tube	Distance focus—cell	Short wave-length boundary of radiation	Photo-current
30 m. amp.	15 cm.	3·5 A.	0·86 μ amp.
50	15	5·5	0·66
150	15	8·0	0·62

Further, below 0·9 μ amp., the photo-current was found to be a rectilinear function of the intensity, when the outer resistance was 100, 300 and 1,100 ohms, thus giving a complete resemblance to the conditions in the case of visible light.

Full particulars of the experimental arrangements and further results will be published later.

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March 30.

[1] Selenyi, P., and Lange, B., *Naturwiss.*, **19**, 639 (1931).
[2] Gleason, P. R., *Phys. Rev.*, **43**, 775 and **44**, 33 (1933).
[3] Scharf, K., and Weinbaum, O., *Z. Phys.*, **80**, 465 (1933).

Composition of Minima in Binary Systems of the Solid Solution Type

IN about twelve of the completely isomorphous binary systems which so far have been investigated, the freezing-point curve passes through a minimum. The compositions of these minima are expressed as chemical formulæ in the accompanying table. This table makes clear the remarkable fact that a simple integral relationship exists between the numbers of the atoms of the two metals in the alloy of lowest freezing-point.

System	Composition of minimum point
Au—Cu	Au_3Cu_3
Au—Ni	Au_3Ni_3
Rb—Cs	RbCs
Rb—K	Rb_2K
Pd—Fe	PdFe (?)
Pd—Co	PdCo
Pd—Ni	Pd_9Ni_{11}*
Pt—Co	$PtCo_3$ (?)
Fe—Ni	$FeNi_3$
Fe—Cr	Fe_3Cr
Fe—V	Fe_3V
Sb—As	Sb_3As

* Perhaps more exact experiment may give PdNi, analogous to PdFe and PdCo.

According to Stockdale[1,2], there is a similar relationship between the components of a binary eutectic mixture. However, perhaps owing to some unknown factor, the relationship is not always one of simple integers in this case, but somewhat complex numbers are sometimes given. The law of simple integral ratios seems to be particularly applicable to binary systems of the solid solution type. A system of this type in which the liquidus curve

passes through a minimum may be considered as intermediate between the more familiar continuous solid solution system of the gold-silver type and a typical eutectiferous system such as the copper-silver system.

Therefore it is to be expected that as the composition at the minimum of a solid solution system can be expressed by a simple integral ratio, so also can the eutectic composition in a simple eutectiferous system be so expressed. Thus the eutectic compositions of the systems copper-silver and rubidium-sodium, simple eutectiferous systems, can be written Cu_2Ag_3 and the $NaRb_3$ respectively, while the compositions at the minima in the copper-gold and potassium-rubidium systems can be written Cu_3Au_3 and KRb_3.

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[1] Stockdale, D., *Proc. Roy. Soc.*, A, **152**, 81 (1935).
[2] Stockdale, D., *Trans. Faraday Soc.*, **32**, 1365 (1936).

Relation of Strength of Wood to Shrinkage

THE swelling and shrinkage or 'working' of wood under varying atmospheric humidity is an important property of the material, and at most laboratories devoted to the study of wood the measurement of shrinkage is made as a matter of routine on all species. With the view of gaining a further insight into the shrinkage process, measurements have been made here on the shrinkage of very small samples of sitka spruce under conditions where changes in vapour pressure and moisture content could be measured simultaneously with the resulting shrinkage.

These experiments have shown that the volumetric shrinkage S could be connected with the Katz swelling pressure P by a simple relation, $S = aP^k$,

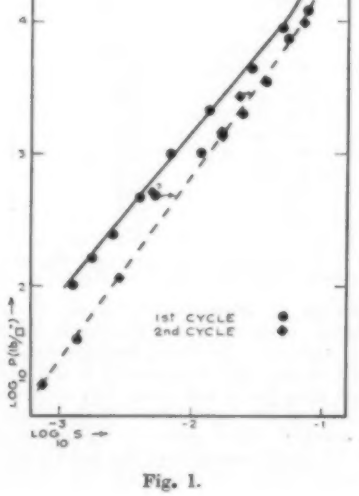

Fig. 1.

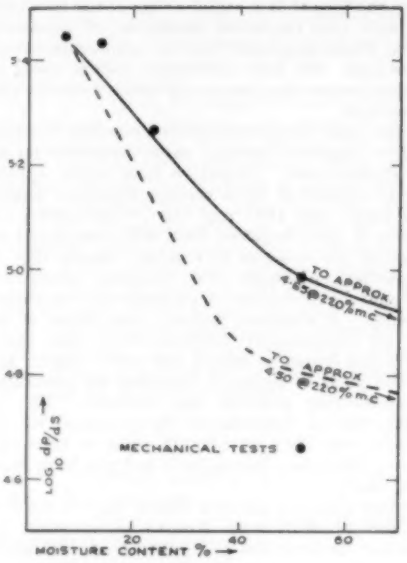

Fig. 2.

where a and k are constants. The equation holds between the waterlogged state (approximately 250 per cent moisture content for sitka spruce) and about 20 per cent moisture content, corresponding to vapour pressures between saturation and about 75 per cent. This range comprises those moisture contents at which most of the water is held by capillary forces. At lower moisture contents, where molecular sorption predominates[1], the shrinkage becomes proportionately smaller than is predicted by the equation. The results of these experiments for the first and second desorption cycles of a particular pair of samples of sitka spruce are shown as a broken line in Fig. 1, together with the results obtained by averaging several routine shrinkage determinations of the same wood, shown as a full line. This graph is, in fact, the stress-strain curve for the shrinkage process, and although neither the shrinkage nor the vapour pressure isothermals for the first cycle are reproducible in subsequent cycles[2], it is interesting to note that the stress-strain curves for the two cycles are indistinguishable in Fig. 1, which suggests that the changes in shrinkage and vapour pressure are due to some modification in the capillary structure of the wood rather than in the material of which this structure is composed.

Further, dP/dS at any moisture content gives the resistance of the wood to unit hydrostatic compression, which may be compared with dp/ds, that found for external mechanical pressures at the same moisture content. In practice, a uniform hydrostatic pressure cannot be applied to a cellular structure such as wood, so that dp/ds is obtained by calculation from unidirectional pressures and the corresponding Poisson ratios. In Fig. 2 the lines show dP/dS against moisture content for the same material as Fig. 1, while the individual points are average values of dp/ds obtained from mechanical tests on some four or five specimens at each of several moisture contents, p being the stress per unit area of wood-water aggregate. It will be seen that dP/dS resulting from shrinkage forces shows, in the case of the routine

tests, a close agreement with dp/ds resulting from mechanical pressure, a fact which it is believed has not been previously established. The lower values obtained from the small samples are explicable as being due to chance selection from a very variable material, but it may well be that very small thin specimens would offer proportionately less resistance to shrinkage forces than the larger material used in the routine tests.

It may be further noted that the lines for log dP/dS are straight at moisture contents less than 30 per cent, which agrees with the well-established fact that for most of the strength properties of wood the logarithm of the property increases linearly as the moisture content falls. Owing to the variability of wood, the individual points in Fig. 2, which concern only a small number of samples, would not be expected to demonstrate this relation accurately.

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[1] Barkas, W. W., *Proc. Phys. Soc.*, **48**, 1 (1936); **49**, 237 (1937).
[2] Barkas, W. W., *Proc. Phys. Soc.*, **48**, 576 (1936).

Two Near Extra-galactic Systems

THE reference in NATURE of April 9, p. 636, to the interesting announcement by Shapley of the discovery of another extra-galactic stellar system similar to the two Magellanic Clouds, at probably double their distance, affords another example of the absolute excess of these near systems in the south galactic hemisphere, within a radius of 10^8 light years. Although the position of the centre of the star cluster is not given, it is stated that it lies in the constellation of Sculptor. It must, therefore, lie not far from the south galactic pole, which is included in this constellation, and in the vicinity of the two spiral systems N.G.C. 55 and 300, both of which are of large angular diameter and therefore among the nearer systems to our Galaxy.

Another comparatively near spiral system which has been observed in recent years at Mt. Wilson and Harvard is that of which the nucleus appears in Dreyer's Index Catalogue as I.C. 342. Originally discovered visually about 1889 by the late W. F. Denning in his sweeps for comets, photographs have revealed that I.C. 342 is the centre of a large condensed spiral system, $40' \times 33'$, and therefore at a distance only about twice that of the Andromeda nebula and the condensed spiral M. 33. Its position in the northern constellation of Camelopardus places it actually in the north galactic hemisphere, but its galactic co-ordinates, $\lambda = 105°$, $\beta = +11°$, show that it lies unusually near the galactic equator, in fact it is owing to its situation behind the galactic star fields that its real character was not detected before. In this case galactic longitude is more important than galactic latitude, for in reality it is one of the elongated group of comparatively near systems, which includes the Andromeda nebula and N.G.C. 891 on the other side of the galactic equator.

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April 14.

Effect of Acetylene on the Ripening of Kelsey Plums

THE Kelsey plum, a Japanese variety, is at its best a plum of outstandingly high quality, but as grown in South Africa, it is notoriously difficult to ripen after picking, even when gathered at fairly advanced maturity and kept at ordinary atmospheric temperatures.

The capacity for ripening appears to vary from season to season, but a 30 per cent ripening is probably above the normal. In the season just concluded (1938), approximately 9,000 fruits of export standard were kept under observation and only 10 per cent of them have ripened satisfactorily at atmospheric temperatures.

During this season Mr. D. J. Dreyer, senior fruit inspector, and I have made experiments on the effect of acetylene on the ripening capacity of Kelsey plums.

The use of acetylene or ethylene as an agent to accelerate the ripening of fruits is, of course, by no means new; but in the present instance the refusal of the fruit to ripen in ordinary circumstances is so obstinate, and its reaction to gas treatment so striking, that it is of interest to put preliminary details on record.

The typical treatment was to expose the freshly picked Kelsey plums, for 24 hours, at atmospheric temperatures (approximately 70° F.) to an atmosphere containing approximately 1 per cent of acetylene, and then to store them at the same temperatures for ripening. Fruits initially green, or green with a trace of red, were fully ripe within five days after treatment; they were full red in colour, luscious and of good flavour. (The uniformity in ripening is a remarkable feature of the reaction, contrasting as it does with the irregular ripening of usual consignments.) Of the control fruits, only 11 per cent had ripened normally after this period, the remainder being unchanged. By the ninth day, altogether 13 per cent of the control fruits had ripened; by the fifteenth day no more had ripened and the remaining fruits had become shrivelled and rubbery.

Ripening initiated by gas treatment appears to proceed quite normally in so far as acid and sugar changes are concerned. The following figures are typical:

	Total dissolved solids	Malic acid	Ratio of dissolved solids to acid
Unripe fruit	15·2 per cent	0·91 per cent	16·7 : 1
Gas-ripened fruit	14·2	0·15	92·8 : 1
Naturally ripened fruit	16·1	0·14	111·8 : 1

These observations have only been made with fruit picked during the latter part of the Kelsey season, and it is impossible to say whether the earlier fruit would have reacted as vigorously.

A positive result was, however, obtained with fruits which had already been stored at atmospheric temperatures for four weeks, and which had given no indication of ripening. The reaction in this case was much slower than with the freshly picked fruit.

In further experiments it has been shown that unripe Kelsey plums can also be ripened by enclosure for a time in a container with naturally ripened fruits. By the third day there was a noticeable difference between the experimental and the control fruits; and by the fifth day the former were full red, while the latter showed from a trace to one quarter of red colour. By the fourteenth day the control fruits had advanced to about three quarters red.

It appears therefore that, just as in the case of the apple and the banana, an active substance (perhaps ethylene) is produced by ripe Kelsey plums, which is capable of accelerating the ripening process in unripe Kelsey plums. There is, however, reason to believe that relative humidity also plays a part, but critical experiments on these lines have still to be made.

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March 26.

The Polysaccharide produced from Sucrose by *Leuconostoc dextranicum*

THE chemical investigation of the 'dextran' formed when *Leuconostoc dextranicum* is grown on media containing sucrose[1] has given information concerning the structure of the polysaccharide and has revealed facts which have a bearing on the general biological question of enzymatic synthesis.

The purest dextran isolated is a water-soluble and non-reducing white powder with a high positive rotation ($[\alpha]_D^{20}$ + 180° in water); it appears to be constituted entirely of glucose units. After hydrolysis by boiling normal sulphuric acid, glucose in crystalline form was separated from the hydrolysate in 92 per cent yield.

No difficulty was experienced in methylating the dextran by the usual procedure with methyl sulphate and sodium hydroxide, and fractional precipitation of the methylated product showed it to be essentially homogeneous ($[\alpha]_D$ 210–214° in chloroform; OMe, 44·5 per cent). The methylated dextran is more stable to hydrolytic agents than is methylated starch. Complete hydrolysis of the methylated dextran was achieved by heating with the reagent usually employed in this laboratory for the hydrolysis of methylated cellulose, namely, 50 per cent aqueous acetic acid containing 4 per cent concentrated hydrochloric acid. Separation of the hydrolytic products was effected in the usual way by treatment with methyl alcoholic hydrogen chloride and fractional distillation in a vacuum.

The principal product of hydrolysis was 2 : 3 : 4 trimethyl glucopyranose isolated as the crystalline β-methyl glucoside (m.p. 94–95°; $[\alpha]_D$ − 21° in water). The trimethyl sugar ($[\alpha]_D$ + 68° equilibrium value) gave a crystalline anilide (m.p. 145–6°), was oxidized by bromine water to a δ-lactone ($[\alpha]_D$ + 80° → + 32° in 21 hr.) and by nitric acid to 2 : 3 : 4 trimethyl saccharolactone methyl ester (m.p. 106–107° alone or in admixture with an authentic specimen).

The fractions obtained in the vacuum distillation of the glucosides were contaminated with methyl lævulinate (characterized as the phenylhydrazone, m.p. 106°), and it was found advisable to remove this constituent by treatment with barium hydroxide and then to refractionate the glucosides. There were indications, chiefly from the refractive index, of the presence of a small amount of tetramethyl methyl glucoside in the first fraction which, after hydrolysis with aqueous acid, had OMe 46 per cent (a trimethyl sugar requires OMe 41·9 per cent). This was confirmed when the methylated sugars from the hydrolysed first fraction were heated with aniline. The anilide which separated was tetramethyl glucose anilide (found OMe 40·3 per cent; $C_{16}H_{25}O_5N$ requires OMe 40 per cent). After recrystallization from absolute alcohol, the anilide had m.p. 135–6° and there was no depression of melting point in admixture with an anilide prepared by the same method from crystalline tetramethyl glucopyranose.

Full details will be published later, but it would appear from these results that the dextran resembles starch and cellulose in that it is constituted solely of glucose residues united to form a chain molecule. The fact that 2 : 3 : 4 trimethyl glucose is the main product of hydrolysis of methylated dextran establishes the nature of the link between the glucose units as being 1 : 6-glucosidic (the gentiobiose linkage) and the isolation of tetramethyl glucose suggests a terminated chain. The proportion of tetramethyl glucose is estimated to be approximately 0·23 per cent of the weight of methylated dextran, which corresponds to a chain length of 550 glucose units. No finality is attached to this latter figure, especially as an osmotic pressure determination gave 200 units, and the possibility of effecting a quantitative separation of tetramethyl glucose as the anilide is being explored.

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Edgbaston.
April 8.

[1] Carruthers, A., and Cooper, E. A., *Biochem. J.*, **30**, 1001 (1936).

The Oxidation-Reduction Potential in Lignifying Cells

DURING the lignification process of the cell walls the carbon content increases considerably. A strong reduction must take place in the living cells which begin to lignify. We have tried to determine the reduction potential of the tissues by means of the colorimetric method applied thus far only to isolated cells (unicellular organisms, and in yeast- and bacteria-suspensions). The results are still of a qualitative character, but they seem significant.

Tissues scraped from the hypocotyledons of the stems of sunflowers by means of a piece of broken glass were used: (1) cortical parenchyma; (2) cambium tissue near the xylem; (3) cambium tissue near the phloem; (4) older wood tissue; and (5) medullary parenchyma. These tissues, after carefully washing off the adherent cell juice, were brought into Thunberg-tubes filled with 8 c.c. of very dilute (0·001–0·005 per cent) solutions of oxidation-reduction indicators (six dyes were used, ranging from rH 18 to rH 8) and 2 c.c. of the Sörensen phosphate buffers (pH = 7). After evacuation, the glass tubes were placed in an incubator at 30° C. Tubes filled only with solutions of the dyes for comparison of the colour, and tubes filled with liquid and killed tissues, which do not reduce, served as controls.

The cambium tissue near the xylem reduced most quickly and intensely. In the cortex the reduction was less marked. The medullary parenchyma had a much weaker action, while the activity of the older wood tissue (of course dead for the greater part) was very scanty.

A corroborative result was obtained with transverse sections of the stem. The results were very satisfactory in most cases, notwithstanding the unfavourable period (autumn). They were, however, variable according to the vitality of the plants used. The

later in autumn the experiments were carried out the more the reducing power was diminishing. In November the reducing power has become very small but, at all times, the cambium showed the highest activity.

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April 6.

Developmental Forms of the Virus of Lymphogranuloma Inguinale (Climatic Bubo)

IT is now generally agreed that in lesions produced by the virus of lymphogranuloma inguinale (climatic bubo) there can be seen small elementary granules which by staining and by differential filtration appear to be 100–175 mμ in size. These granules almost certainly represent the etiological agent of the disease. In smears from infected mouse brains these granules may occur (1) diffusely scattered outside the cell, in the form of colony-like masses; (2) within the cell cytoplasm, when they may be surrounded by a definite membrane; or (3) closely adherent to ruptured cells. The granules are stained blue by Castaneda's stain, blue with Victoria B, and reddish-violet by Giemsa's method.

In addition to the small forms, though less numerous, we have been able to find, in lesions produced by three strains of the virus, large bodies three to four times the size of the small forms. These large forms are present especially in very early lesions, and are somewhat irregular in shape, often suggesting division by fission: intermediate bodies between the large and small forms also occur. Very occasionally small masses of large forms only are seen occurring in plaques; more commonly collections of small granules are found containing a few large forms.

The evidence at present available suggests that the small granules are derived by division from the large forms. These large forms stain a bluish-violet by Giemsa and a reddish-purple by Castaneda's method. The various forms of the virus of lymphogranuloma inguinale present many analogies to those exhibited by the causal agent of psittacosis.

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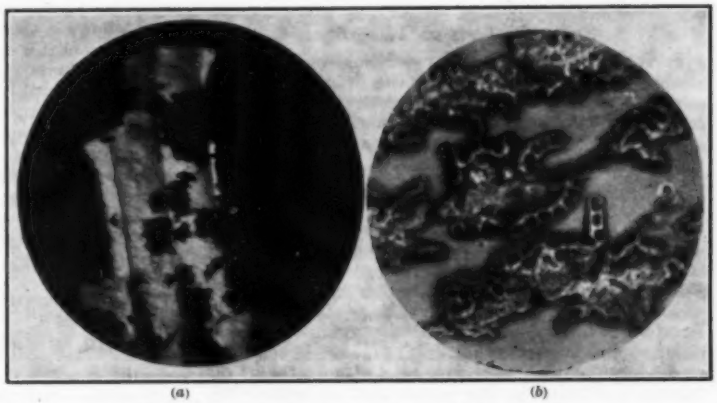
Disintegration of Cell-Wall Substances in the Gastro-Intestinal Tract of Herbivora

THE process of cellulose digestion in herbivora, in addition to its economic importance, throws considerable light on a number of cognate biological topics. Biochemical aspects of the problem have received considerable attention. Pure cultural investigations have been attempted though it is questionable whether the species isolated *in vitro* are those primarily concerned with the process taking place *in vivo*. It is therefore remarkable that so few attempts have been made to study the changes occurring *in situ* by direct microscopical observation. This method has been successfully applied by us to material derived from the cæcum of non-ruminant herbivora.

Disintegration is evidenced by the formation of clearly defined zones of erosion termed *lacunæ*. In the affected regions loss of double refraction corresponds precisely to changes in microchemical and staining reactions. Stages in micellar disorganization are indicated by diminution or loss of dichroic intensification. Pectic substances are dissolved (ruthenium red). Cutin entirely resists attack (Sudan III). Heavily lignified structures are immune. By the use of appropriate reagents and stains, the cytoclastic micro-organism can be demonstrated in the interior of lacunæ.



(*a*) (*b*)

PLANT STRUCTURES FROM CÆCUM OF THE HORSE.
(*a*) Epidermal tissue. Polarized light. Crossed nicols. Localized disappearance of double-refraction in the zones of erosion or lacunæ (black). × 400 approx.
(*b*) Stained Congo-red and iodine. Lacunæ situated in pink substratum which shows dichroic intensification with a single nicol (Ambronn effect). At the edges of the lacunæ the cytoclastic micro-organisms can be seen (blue, with iodine). The staining at the margins of the lacunæ is intensified. × 1,200 approx.

The above methods when applied to material from the cæcum of the guinea pig[2,4], rabbit[3] and horse (in the press) yield strictly comparable results. The cytoclastic micro-organisms include vibrionic, coccoid and giant forms[2,4]. It appears that they are stages in the life-cycle of some polyphasic species. The coccoid and giant forms give a blue (amylodextrin) reaction with iodine. Their shapes correspond with precision to the contours of the excised lacunæ.

These investigations have recently been extended to the stomach of ruminant herbivora. In the sheep, disintegration of the optically birefringent substances of the wall has been demonstrated by the application of the methods outlined. The primary agents are iodophile micro-organisms very similar to those observed in the cæcum of the species mentioned. To the indigenous protozoa of the paunch only a subordinate role can be assigned. The size of the plant fragments originally present is such as absolutely to

prohibit ingestion. Smaller fragments are afterwards ingested; but these have in the majority of cases been detached, and in consequence already in part disintegrated, by the activities of the iodophile micro-organisms. Similar considerations hold for the protozoa of the horse. In both instances, however, digestion of starch grains and iodophile micro-organisms has frequently been observed.

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[1] Baker, F., Preliminary Note on the Role of the Coccoid Micro-organisms in the Disintegration of Cell-Wall Substances", *Zent. f. Bakt.*, Ab. II, **84**, 452 (1931).

[2] Baker, F., "Studies in the Microbiology of Organisms associated with the Disintegration of Vegetable Remains", *Zent. f. Bakt.*, Ab. II, **88**, 17 (1933).

[3] Baker, F., and Martin, R., "Some Observations on the Iodophile Microflora of the Caecum of the Rabbit: with special Regard to the Disintegration of Cell-Wall Substances", *Zent. f. Bakt.*, Ab. II, **96**, 18 (1937).

[4] Baker, F., and Martin, R., "Observations upon the Disintegration of Cell-Wall Substances in the Caecum of the Guinea Pig", *Zent. f. Bakt.*, Ab. II, **97**, 201 (1937).

Scientific Tests of Telepathy

IT is probable that most psychologists and practically all physiologists regard the evidence in support of 'clairvoyance' and 'telepathy' as worthless from a scientific point of view. So naïve, as a rule, are the arguments used by those anxious to give verisimilitude to the results of imposed tests that few scientists are willing to discuss or even seriously to consider these subjects with their question-begging titles. This is regrettable, as the public are apt to draw erroneous conclusions when they see reiterated statements in the popular press pass unchallenged. For this reason Mr. S. G. Soal, senior lecturer in pure mathematics at Queen Mary College, University of London, is to be congratulated on having conducted detailed investigations into certain alleged 'psychometrising' faculties of the medium 'Marion', and for having published in the press[1] and elsewhere[2] his conclusions thereon. It is yet more a subject for congratulation that a periodical of the scientific status of NATURE[3] is willing to devote space to reports upon investigations of this subject.

"In spite of all the vast tomes that have been published on psychical research," writes Mr. Soal in the Bulletin (p. 3) to which reference has been made, "I have yet to meet the human being who under similar conditions can do what Marion has failed to do!" This, one of many comments—all adverse to a telepathic interpretation—appended by Mr. Soal to the results of the experiments, both recalls and endorses the following dictum by the late Sir Ray Lankester.

"Telepathy is simply a boldly invented word for a supposed phenomenon which has never been demonstrated. It is an unfair and unwarranted draft on the credit of science which its signatories have not met by the assignment of any experimental proof. There is not one man of science, however mystic and credulous his trend, among those who pass this word 'telepathy' on to the great unsuspecting, newspaper-reading public, who will venture to assert that he can show to me, or to any committee of observers, experimental proof of the existence of the thing to which this portentous name is given."

The late Sir Bryan Donkin, a psychiatrist of considerable repute who had devoted no little attention to the claims of 'thought-readers', used to say of the above quotation that it constituted a masterful summing up of the whole case for telepathy.

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Surrey.

[1] *Sunday Times*, March 13, 1938.
[2] Bulletin 3. University of London Council for Psychical Investigation.
[3] NATURE, **141**, 565 (March 26, 1938).

Science and the Unobservable

IN Prof. Dingle's lucid rejoinder to my letter[1] the difference in our points of view stands out very clearly. It hinges on the meaning of such terms as "denial" and "pronouncement".

I do not think that relativity as a scientific theory "denies" the existence of absolute simultaneity in the dogmatic sense in which Prof. Dingle seems to employ that word; the third horn of the dilemma on which he would impale me thus turns out to be made of sand. Stated explicitly, relativity as a scientific theory makes only such pronouncements as the following concerning absolute simultaneity: (1) at present it is not a significant concept in physics; (2) known facts raise a presumption or expectation that it never will be; (3) if we assume certain postulates or working hypotheses which preclude the existence of absolute simultaneity, such and such conclusions follow. That is all.

Precisely this careful avoidance of *dogmatic* pronouncement seems to me to be of the very essence of the scientific method, and I think it is a mode of approach that is badly needed in attacking many other problems.

E. H. KENNARD.

Cornell University.
April 8.

[1] NATURE, **141**, 557 (March 26, 1938).

I AGREE with Prof. Kennard's three statements on the pronouncements of relativity, but if, as he truly says, "That is all", what has become of the "world existing independently of experience" which was regarded as essential in his first letter? Of the three attitudes which I considered incompatible, he has chosen those of the relativist and the non-professor of omniscience, and abandoned that of the realist as defined; he is now entirely in the realm of concepts, known facts, assumptions and rational deductions. In the terms of my former letter, he has shown no reason for giving $A - A' - A''$ a non-zero value. Immediately, therefore, he adds the realist contention that it has such a value, he makes an unfounded statement and so becomes dogmatic.

I would add that I am in complete agreement with Prof. Kennard concerning the undogmatic character of the scientific method, and the need for its more general application. The importance of this matter, particularly in the social, political and religious spheres, is, indeed, one of the chief reasons why I think it is necessary to see science exactly as it is without adding to it a totally irrelevant "independent universe" which fulfils no function but that of making false philosophies plausible.

HERBERT DINGLE.

Imperial College,
London, S.W.7.
April 29.

Social Relations of Science

THE Association of Scientific Workers has been mentioned in several of the contributions to the supplement in NATURE of April 23 on the proposed Society for the Study of the Social Relations of Science. On behalf of the A.S.W., I venture to direct the attention of readers to our work during the last ten years in the field which the S.R.S. proposes to cover.

The A.S.W. has a dual policy which includes the study and the improvement of the relations between science and society as well as the promotion of the professional interests of scientific workers. The Association has endeavoured to pursue the first object of its policy by publishing a journal called *The Scientific Worker*, by holding public lectures, and recently, by arranging showings of scientific films. For lack of adequate means we have not been able to satisfy the urgent need for properly organized research into the influence which many aspects of science are now exerting on our social life. Such work could only be done under the auspices of a society such as the S.R.S., and we are glad to notice that, in the contributions to the supplement in NATURE, several of our vice-presidents emphasized this aspect of the future work of the S.R.S. It is also necessary that the general public should be kept more in touch with the actual nature and purpose of scientific education and research.

The potentialities of an S.R.S. seem to us to be very great, and we should both welcome its formation and willingly co-operate in its work.

W. A. WOOSTER.
(Honorary General Secretary.)

Association of Scientific Workers,
Kelvin House,
28 Hogarth Road,
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Points from Foregoing Letters

FROM the behaviour of a special preparation of heart muscle, containing a high concentration of cytochrome *a*, when treated with various reagents, Prof. D. Keilin and Dr. E. F. Hartree deduce that the absorption band *a* of cytochrome belongs to two slightly different compounds, one of which is autoxidizable and combines with potassium cyanide or carbon monoxide, while the other does not possess these properties. They also enumerate reasons for suggesting that the enzyme which oxidizes cytochrome may be a copper-protein compound.

By irradiating carbon disulphide for several days with neutrons in presence of a strong electric field (70–90 volts per cm.), J. Govaerts has been able to concentrate the radiophosphorus produced almost entirely upon the anode, which increased in weight by 3·7 mgm.

There are two kinds of imperfection causing loss of resolving power in the X-ray spectra of crystals, according to J. M. Bačkovský. One is due to mosaic structure and the other to the regular atomic planes. By using a symmetrical spectrographic arrangement for X-ray study in which the distance slit to crystal equals the distance crystal to photographic plate, the author has been able to reduce the broadening of the lines due to mosaic structure and to render its effect negligible.

Dr. R. H. Sloane and R. Press describe some new experiments on the formation of negative ions by the bombardment of metal surfaces with positive ions. These experiments show that positive ions of one species can produce negative ions of another species, and this seems to require a sputtering mechanism for its explanation.

Photo-electric selenium cells are found by Dr. A. E. Sandström to be susceptible to X-rays of long wavelength, somewhat below 20 A. Under suitable conditions the photo-electric current is proportional to the intensity as in the case of ordinary light.

A table is given by M. Hara, showing that in twelve bimetallic alloys with lowest freezing point the metals are in simple atomic ratio, corresponding to that of simple chemical compounds (Au_3Cu_1, $FeNi_3$, etc.).

Graphs showing the relation of swelling pressure to shrinkage in the case of samples of sitka spruce, and also the resistance of the wood to compression at different moisture contents, are submitted by W. W. Barkas and H. Q. Golder.

Successful ripening of the Japanese Kelsey plum grown in South Africa, by treatment of acetylene, is reported by V. A. Putterill.

Chemical investigation of 'dextran', a compound synthesized by the seaweed *Leuconostoc dextranicum*, when grown in a sugar solution, shows that carbohydrate to be similar to starch and cellulose, being constituted solely of glucose residues. There appear to be several hundred glucose units in the dextran molecule.

During the lignification of plant cell-walls, an increase in the carbon content and consequently a reduction process takes place, according to K. Griffioen. Colour tests with oxidation-reduction indicators support this view as they show that the cambium layer near the wood cells has greater reducing power than other cells, particularly during the growth season.

Dr. G. M. Findlay, R. D. Mackenzie and F. O. MacCallum report the presence of Giemsa-stained granules in early lesions of the virus disease, climatic bubo, these being three or four times larger than the previously observed (presumably virus) granules. The authors suggest that the smaller granules are derived from the larger ones by division.

F. Baker and R. Martin demonstrate the disintegration of optically birefringent cellulose and other cell-wall substances in the cæcum of the horse, etc. Loss of double-refraction in the zones of erosion is accompanied by changes in microchemical reaction. Pectins are also attacked. Lignin and cutin appear to be immune. The cytoclastic agents are iodophile micro-organisms, probably stages in the life-cycle of a single polyphasic species. Protozoa, where present, play, if any, only a subordinate part in the process of disintegration.

Research Items

Navaho Ceremonial

IN view of the comparatively limited character of knowledge of the ceremonial complexes of the south-western Indians of the United States, the Department of Anthropology of the University of Chicago has been induced to sponsor a series of studies combining the study of Navaho ceremonialism with an intensive study of the language. The first of the series is the text of "Enemy Way", commonly known to the white population as the war dance, one of the most popular ceremonials ("Origin Legend of the Navaho: Enemy Way". Text and Trans. by Father Berard Haile. *Yale Univ. Pub. in Anthropology*, 17, 1938; Oxford Univ. Press. Price 16*s*. net.) In Enemy Way there are a number of ceremonies, each with a specific ritual function, such as "decorating the rattle-stick", "strewing the ashes", etc., each of which is accompanied by sets of songs. The term 'shaman', as generally understood, is foreign to native conception. Though the 'singers', both men and women, are a distinct class in the tribes, their organization is very loose: they do not form lodges, fraternities or schools, while a singer does not offer his services, but awaits a summons. Their knowledge is not restricted by clan, or heritable. It may be purely mechanical and limited to the reproduction of songs required by a given ritual. The power to function as a singer, however, is transmitted from singer to pupil; and no one, however familiar with the material, would act as singer, unless he had been inducted. Women are not barred, although there are few female singers to-day, and in Enemy Way none, because women are not warriors. The Enemy Way legend, conceived as a whole by the narrator, may for convenience be treated as falling into three parts. Of these, the first deals with the origin of the people from the underworld, and their struggle with the man-devouring monsters, who originated from the sexual misdeeds of the women. This struggle made the earth fit for the present human race, which is identified with the Navaho. The second part of the text describes the war on Taos, in which a number of ritual practices, typical of tribal war, are described. The third gives an account of the Enemy Way ceremonial by which the patient, personifying the earth suffering from these conflicts, is put right.

Function of Golgi Apparatus

IN a further study of the structure of the Golgi apparatus, Dr. M. K. Subramaniam has observed in alimentary canal cells of *Lumbriconereis* two types of secretion (*Proc. Indian Acad. Sci.*, 8, Sect. B, 125, March 1938). In cells producing a watery mucous secretion, the Golgi apparatus consists of granules and vesicles. The secretion vacuoles arose in contact with the chromophilic rim of the Golgi vesicles. In cells producing the granular type of secretion three types of association between the Golgi bodies and the secretory product were observed: granules arose in intimate relation with the idiosome of the Golgi batonettes, developing granules were closely pressed against small Golgi vesicles, and typical Golgi batonettes, double-rimmed batonettes and Golgi vesicles were seen plastered on the surface of a secretory granule. The author is convinced that there is some fundamental plan in the Golgi apparatus common to all cells, whether vertebrate or invertebrate, and that the different patterns in different cells when analysed resolve into variations of a single basic procedure.

Indian Breeds of Cattle

THE study of native breeds of cattle has assumed great importance since it was realized that they possess a power of disease resistance often lacking in imported breeds of European strains, and that united with this quality they often possess a potentiality of improvement under suitable conditions of husbandry. The humped cattle of India are of special importance in such studies on account of their numbers, estimated at 200 million, and of the part they have played in the development of some of the widely diffused breeds of African native cattle. In "A Brief Survey of some of the Important Breeds of Cattle in India", published at the instance of the Imperial Council of Agricultural Research (*Miscellaneous Bulletin* No. 17; 1938), Sir Arthur Olver describes the distribution and outstanding characters of twenty-one breeds of cattle and four breeds of buffaloes, illustrated by 52 plates of photographs. The cattle breeds fall into five basic types, which appear to have been brought to India at different times with waves of immigration from various centres. The descriptions and photographs convey the impression that India possesses great wealth of fine cattle breeds, well worthy of development by selection and research. The possibilities are great, for it has already been shown that, in comparatively few years, selected milch breeds of pure Indian origin can, by scientific feeding and management combined with systematic breeding control, be raised to levels of efficiency as high or higher than those of imported European cattle or their cross-breeds.

Tobacco Leaf-curl in Northern India

Dr. B. P. Pal and R. K. Tandon of the Agricultural Research Institute, New Delhi, have presented a first report (*Indian J. Agric. Sci.*, 7, Pt. 3, June 1937) on the investigation undertaken at Pusa on the tobacco disease known as leaf-curl, which is becoming a serious menace in northern India. They identify the disease with that described by Thung in Java under the name of 'kroepoek' and with the leaf-curl of East Africa which Storey studied and showed to be conveyed by a species of white fly. The authors distinguish five different types of disease, four of which they regard as distinct and due to different virus agents, and the fifth as due to a mixture of two or more of the former. Indeed, by grafting scions from two of the distinct types on to a healthy plant, they have reproduced a clinical condition indistinguishable from that regarded as the fifth disease under review. There is evidently a close resemblance between the types of disease found in

India and those observed by Thung in Java. The presence of carriers amongst weeds common to the Indian plantation is suspected, but no definite evidence of such has been adduced.

Silicon Monoxide

W. Biltz and P. Ehrlich (*Naturwiss.*, **26**, 188; 1938) report the interesting fact that on heating a mixture of equimolecular proportions of silicon and silica to 1400° in a vacuum, volatilization occurred to the extent of 80 per cent in an hour. Silicon itself would only volatilize to the extent of 10 per cent under the same conditions, and quartz has no appreciable vapour pressure. A vitreous sublimate, which was brown in thin layers, and brownish-black in thicker deposits, was obtained, and most of it could be resublimed. It seems possible, but not certain, that the product may be silicon monoxide. This substance has, of course, been previously prepared by the reduction of silica with carbon in the electric furnace, and has been used as a pigment, and for other purposes.

Heat Resisting Steels

PROGRESS in the metallurgical industry during recent years has been towards the provision of a number of alloy steels which are capable of withstanding both oxidation effects and high stresses at enhanced temperatures. On March 24, W. H. Hatfield presented a paper to the Institute of Fuel in which he recorded the results of experiments carried out on fourteen different compositions, including mild steel. The purpose of this experimental work was to make a comparison of the properties and characteristics of these steels and at the same time evolve a basis of evaluation of their efficiency for specific purposes. Consideration of the data shows that there are steels available which have a time yield of not less than 3,360 lb. per sq. in. at 700°C., whereas that of mild steel at the same temperature is of the order of 400 lb. This in point of fact means, when translated to everyday requirements, that reasonable permanence of dimensions can be anticipated from certain steels, and reasonable stresses can be borne by them even at a red heat. Further, various ingredients such as nickel and tungsten may be added to increase the strength of steel. It is therefore incumbent upon the engineer before selecting steel to consider carefully the service required of it and also the conditions of service, such as temperature distribution, atmosphere and general physical conditions, so that the right ingredients may be incorporated in the steel in suitable proportions.

A Randomizing Machine

IN certain statistical investigations it is necessary to have a set of random sampling numbers. The only table of such numbers at present in existence is due to L. H. C. Tippett, who compiled it by taking digits at random from census reports. There is some difference of opinion as to whether this method is reliable, but whether it is so or not, there is certainly a need for more extensive tables. To produce these, M. G. Kendall and B. B. Smith have designed a randomizing machine (*J. Roy. Statistical Soc.*, 101, 147; 1938). This consists of a disk divided into ten equal sections, on which the digits 0 to 9 are inscribed. The disk rotates rapidly, in a dark room, at a speed which can be made very approximately constant by means of a tuning fork, and it is illuminated by a series of flashes from a neon lamp. At each flash a number is chosen from the apparently stationary disk by means of a pointer fixed in space. The first five thousand digits obtained in this way are given in the appendix to the paper mentioned above. Four tests for randomness (the 'frequency', 'serial', 'poker' and 'gap' tests) were applied to these numbers, with satisfactory results in each case. Further experiments are needed before it can be established that the results will be equally satisfactory for much more extensive sets of numbers, but the preliminary results are very encouraging.

Observations of Meteor Showers in Japan

SHOWERS of Orionid, Leonid and Geminid meteors were observed last year by Mr. K. Komaki, Mrs. Komaki, and Mr. K. Yosii, at Kanaya and Takehara. The Orionids were not so rich as in the previous year, but the Leonid shower was slightly richer than it has been for some years. Mr. Yosii discovered a new stream, the radiant of which was R.A. 72°, Dec. + 37°. These meteors were white or yellow and their motions were slow. The Geminids were observed on December 6–15, and the frequency was about the same as in previous years, the maximum occurring on the morning of December 14. On December 12 and 13 the radiant was close to R.A. 112°, Dec. + 32°, and on the morning of December 14 Mr. Yosii detected two showers from R.A. 109°, Dec. + 30°, and R.A. 122°, Dec. + 33·5°.

A Variable-Frequency Telescope Drive

THE recent paper by Mr. H. W. Cox under this title (*J. Brit. Astro. Assoc.*, **48**, 6; April 1938) will be useful to amateurs who wish to instal an efficient and cheap drive for their telescopes. The mechanism depends upon the principle that in a synchronous type of motor the motor speed is proportional to frequency, and this latter is varied by what is practically a radio set on the bottom end of the telescope. If a coil and a condenser are connected in parallel, they have a natural resonant frequency, and this can be regulated by varying the capacities. Hence it is possible to arrange a resonant frequency of the circuit which will coincide with the operating frequency suitable for any synchronous motor that is desired. The tuned circuit is unable to drive the motor, but by connecting the tuned circuit to an ordinary radio valve, the circuit and valve can be made to oscillate and produce a 50-cycle voltage of 10 or 20 volts, which can be brought up to 200 volts by another ordinary type of radio valve. When the voltage and power have been amplified to the correct amount, connexion to the motor is made through a transformer, just as a loud-speaker is connected to a radio receiver. The frequency is varied, as already mentioned, by altering the condenser or coil, and as the former is made up of a number of small units, each of these smaller condensers being connected independently into the circuit by a switch, the rate of the motor can be regulated. Mr. Cox supplies three diagrams with his paper, and those who are skilful with manipulating wireless sets should be able to fix up the drive for their telescopes, as the diagrams show the method of connexion and also various refinements introduced to produce the most accurate results.

Speech and Civilization

By Sir Richard Paget, Bt.

IT is a very remarkable fact, little known to students of human speech, that uneducated deaf mutes, even to-day, have no inborn knowledge of any sign or symbol equivalent to a word. They naturally symbolize their ideas by a general pantomime describing events as a whole. They have not got the power of analysing their environment into separate categories of objects, actions, qualities, etc., or of symbolizing such separate elements by bodily signs equivalent to our spoken words.

The fact that intelligent human beings, skilful with their hands and capable of craftsmanship, are still in this primitive and unanalytic state of mind—in which they are unable to define anything because they have no units with which to define—seems to indicate that our present powers of analysis and of separate symbolization of the elements out of which our general impressions are composed, may be a comparatively recent acquisition of mankind. It also seems possible that the acquisition of this power may be closely allied to what we call 'civilization'.

Assuming that the development of true speech arose from primitive man's acquisition of the power of analysing his environment (as presented to him by his various senses) and of symbolizing the component parts in units and categories—equivalent to our 'parts of speech'—how did this process begin?

Perhaps the evidence of primitive man's artistic skill, for example, in his early cave drawing, sculpture and modelling, may give the clue.

Primitive man—keen hunter—skilled in recognizing shapes (cf. Pavlov's dogs)—must have often come across natural flints (which were of special interest as the raw material of his tools and weapons) of peculiar shape, which reminded him of certain animals—birds—or even human beings. Stones with curious holes through them—so that they could be made into 'knob-kerries' by pushing a stick into the hole—or smaller stones which could be threaded on a leather thong or a fibre string, and worn as ornaments, would also be very interesting, and 'magical' to him. It would not be long before man would try his hand at improving such finds, for example, by knocking off excrescences which 'spoilt' the form of a particular piece of natural sculpture.

It would also be natural that man should observe the plastic qualities of clay, and the way it preserved the imprints of animals and birds and of man himself, which appeared on it. As we know, he did make imprints of his hands on the walls of some of his caves.

Beginning thus with sculpture and modelling, it would not be long before man began outlining other objects, just as the imprint of his foot or hand on a soft surface of clay incidentally outlined the shape of the palm, or the sole of the foot.

The new factor in all this was that the artificial animal, bird or human, or the imprint or drawn outline symbolize the creature in question apart from its environment. The object symbolized could be considered by itself, apart from any environment; it could be viewed in any position, at any time, in any place where its owner chose to take it, or wherever he modelled or drew or impressed it.

Primitive man was not limited to the symbolizing of objects; he could also symbolize actions, such as hunting, dancing and other bodily movements or postures, namely, by drawing crude representations of the actions in question.

The same method of representing actions was later developed by the Red Indians of North America, so that it became a complete script. The Chinese, Sumerians and Egyptians developed a similar technique, which ultimately became formalized as the Chinese ideograph, cuneiform and hieroglyph, respectively.

Thus, it may be that primitive man acquired the art of analysis of impressions, and of the symbolization of separate elements of his impression, from his first observations of natural objects which he recognized as being like other objects!

The moment he began to study natural objects with the view of drawing or modelling them, he had to concentrate his mind on them and, in fact, to isolate them from their environment, for the act of drawing or modelling was in itself a symbolizing of the model, or of the action or quality which he portrayed.

It seems likely enough that this process of symbolizing by drawing or modelling should have been used very early, in magical practice; indeed, the power of producing stones, clay shapes or drawings, which looked like or suggested living forms, must have appeared highly magical to the tribal contemporaries of the earliest artists. It may well be that the artists were in fact the earliest 'priesthood'.

Turning now to the evolution of speech, the pre-analytic stage of sign language was, obviously, accompanied by an emotional 'gabble', due to the (Darwinian) sympathy of movement between man's hands and mouth. As man acquired the art of symbolizing animals, men, women, bodily actions, relative positions, sizes and other qualities, etc., namely, by drawing symbols of them on a flat surface, he would equally acquire the art of symbolizing these elements by bodily pantomime (including in this the art of outlining in the air) as educated Chinese to-day draw ideographs to be read by a Chinese who speaks a different dialect but uses the same method of ideographic writing. In this way, an analytic form of sign language would naturally grow up; combined, of course, with general (non-analytic) pantomime. The gabble would thus tend to be gradually combined with particular mouth movements (due to corresponding hand movements) which always meant the same thing—that is, with actual words.

It would be interesting to know whether a study of the speech of the most primitive tribes of mankind gives any evidence of this process—the use of bodily pantomime of a more or less free and unstandardized type (accompanied by an emotional vocal gabble) combined with the use of standardized words for such objects, actions, etc., as would naturally be symbolized in very early stages of human development. It would also be interesting to know whether

there are any primitive tribes on record who, when discovered, had not reached the stage of artistic imitation of any natural object.

On the theory above indicated, such a tribe might still be in the 'gabble' stage of speech, and, in fact, in the same stage of mental development as uneducated deaf mutes are to-day.

In their case, as was said above, and as is well known to those who are concerned with the education of deaf mute children, the deaf mute naturally expresses himself by free pantomime. The elements of meaning are not analysed into their component parts (as objects, actions, qualities, spacial relations, etc.) each represented by a separate invariable symbol, but are represented as 'events as a whole'.

Indeed, the main difficulty in the education of the deaf mute arises from the fact that he cannot—by Nature—understand what a word is, and has no gestures corresponding to words. He can perfectly appreciate events and invent for himself a pantomime which will bring the same event to the consciousness of his fellow deaf mutes, and this pantomime is so natural and expressive that (as is well known) the deaf mutes of all nations have no difficulty in communicating with one another.

The importance of a verbal type of gesture language (with separate, invariable signs for each element of meaning) lies in the fact that with this power of separate symbolism comes the power of making new syntheses, and that this power may have been almost wholly lacking before the necessary analytical and symbolic powers were evolved. Man's 'inventive' power would then have been on the same plane as that of the animal world.

It is evident that words, depending on mouth gesture, associated with hand gesture of a standardized (analytic) type, could only at first express concrete ideas; namely, such objects, actions, spacial relations, qualities, etc., as could be symbolized by bodily attitude or movement—posture or gesture.

The faculty of symbolizing abstract ideas depended entirely on the use of man's 'poetic' faculty, especially the faculty of seeing analogues between abstract and concrete, as, on our hypothesis, he had seen the analogy between a curiously shaped stone and a bird or animal.

Thus, to the Red Indian, *joy* was *sunshine* (*in*) *heart*; sunshine and heart are both easy ideas to symbolize in signs. So joy can also be symbolized. Similarly:

sorrow	was	*heart on the ground*
ambition	,,	*man push rise*
truth	,,	(*the*) *straight trail*
false	,,	(*to speak with*) *two tongues*
mean	,,	*heart small*
luck	,,	*turn up* (*in the Indian gambling stick game*).

It is entirely on this principle that all words for abstract ideas have been formed throughout the world. Thus (Greek) metaphor is, literally, to carry across, that is, from the concrete to the abstract.

Or take the idea of fear. This is commonly symbolized by the use of a concrete symbol meaning to shrink, or draw back (as in the Red Indian hand gesture for fear) or by reference to one of the concrete effects of fear, trembling, paralysis or the like, or to some concrete action calculated to cause fear.

Thus, in archaic Chinese, out of 14 separate words meaning fear (according to Karlgren[1]), 6 are produced by what are in fact drawing-back actions of the tongue, or lips and tongue (with or without a preliminary forward motion)—KING, LAK, KUNG, SUK, WEI, T'IEUT; 2 are produced by mouth gestures related to shivering—LIET, LIEM; 4 are related to concrete gestures meaning to bind, grip or seize, scatter or strike—L WO, P'A', P'UO', D'ÂN—and only 2—KI, G'IU—which might mean to drop at the back, and to pour out, respectively—are not obviously related to any concrete action connected with fear.

Such instances of the developments of abstract signs (or words) by the poetical use of concrete symbols could be multiplied almost indefinitely. The few which have been given may suffice to show how important the poetic instinct in man has been in providing a ready means for expressing abstract ideas by the 'metaphorical' use of concrete symbols. It is probably true to say that but for the poetic instinct man might for ever have been limited to the narrow field of concrete ideas.

But what really distinguished man from the higher apes was that he had become a symbolizing animal, and that symbolism was the mother of invention.

[1] "Analytic Dictionary of Chinese."

Presentation of the Kelvin Medal to Sir J. J. Thomson

THE Kelvin Medal, which was founded to commemorate the work of Lord Kelvin, is awarded triennially by a committee in London consisting of the presidents of eight of the leading engineering institutions of Great Britain, after consideration of recommendations received from similar bodies in all parts of the world. Sir J. J. Thomson was selected as the recipient of the award for 1938 (see NATURE, May 7, p. 825) and the presentation was made on May 3 in the Great Hall of the Institution of Civil Engineers by Lord Rayleigh on behalf of the Kelvin Medal Award Committee. Lord Rayleigh's address is printed below.

It is more in accordance with the natural order of things that a master should present a prize to a pupil than that a pupil should present one to a master. Those who stood in the relation of master to the man that we are met to honour to-day (and I am proud to remember that my own father was among them) have passed into silence: and the duty falls to one of a younger generation.

Sir J. J. Thomson tells us in his "Recollections and Reflexions" that he was originally intended for the career of an engineer. Fate had apparently decided otherwise; but the most direct route is not necessarily the only one. In spite of this apparent renunciation, he is here to-day to receive the Kelvin Medal, perhaps the highest distinction which the engineering profession has to confer. It is a tribute to the breadth of view of the profession that this should be so. When the Faraday centenary was in

course of celebration, it occurred, I believe, to some influential members of the Institution of Electrical Engineers that the terms on which their membership was granted would perhaps have excluded Faraday himself. We may look on the present award as a healthy reaction from that state of things. It shows that the bodies making the award are animated by no narrow spirit of professionalism. The doctors learnt much from Pasteur, though he was not a member of their profession. Similarly, the engineers have learnt much from J. J. Thomson.

Let me remind you of some of it; and let me say that I am not speaking from book knowledge, still less from hearsay. I was working in the Cavendish Laboratory when many of the things were done, and I saw them in progress. The professor was very much the reverse of a mystery man—he told us freely of his half-formed ideas, and even allowed us to argue with him about them. For example, he was much exercised about the nature of cathode rays, the properties of which had been so well described by Hittorf, Crookes, Goldstein, and Lenard. Were they a stream of electrified particles, or were they not? At first the only fact with a really clear bearing on this question was the magnetic deflection. Thomson was one of those who saw most clearly the full strength of this argument. But he saw that there ought to be an electrostatic deflection as well, when a transverse electromotive force was applied; and that did not seem to happen. Why not? Thomson wondered whether the electromotive force really was being fairly applied. He found that the cathode rays made the residual gas in the vessel very conductive. The result of this was that all the applied voltage was ineffectively dropped on the space near the transverse electrodes where the rays were not. The remedy for this was to have as little gas as possible. High vacua were not so easily made then as they are now. However, the difficulty was overcome, and the transverse deflection observed.

What has all this got to do with engineering? Well, take the cathode ray oscillograph, the tool of the electrical engineer for dealing with all problems concerning rapid surges of current and potential. What is this but a glorified edition of the apparatus with which Thomson observed the electrostatic deflection of cathode rays, and discovered the electron? Again, take television. Does not cathode ray television depend on the use of electrostatic deflection to cause the cathode beam to scan the picture? If we did not know that the cathode rays were charged particles, should we have known how to retard them by longitudinal electric forces, so as to modify the energy, and produce the light and shade of the picture?

I have taken a few direct examples coming immediately from Thomson's own researches. But his services to engineering by no means end with them. There can be little doubt that his early writings on electric waves and oscillations were a main source of inspiration to those who were concerned with the development of wireless and of high-frequency electrical engineering generally. Before he turned his attention to electric discharge phenomena, there was so far as I can recall no systematic treatment of the subject, and when it came to the development of the three electrode valve, and the various forms of electric discharge lamps which now light our streets, it was to Thomson's writings that the inventor turned for guidance.

William Herbert and Amaryllis Culture

"HERBERT bridges the gap not only between Ray and Darwin but also between Kölreuter and Mendel," writes Dr. C. D. Darlington in "Herbertia", the year-book of the American Amaryllis Society for 1937[1]. The Hon. and Rev. William Herbert was for thirty-three years rector of Spofforth in Yorkshire. He published, in 1837, a volume on the Amaryllidaceæ, which must still be consulted by any serious student of the genus, and fully warrants the Society's choice of the title "Herbertia" for its year-book. An addendum to Herbert's volume of 1837, entitled "On Crosses and Hybrid Intermixtures in Vegetables" was, moreover, a classic which fully justifies Dr. Darlington's estimate. The text appears in the 1937 "Herbertia" and should be read for its historical value as a portrayal of early work on conscious hybridization.

Few year-books achieve such monographic treatment as "Herbertia". Full consideration is given to the Society's affairs and regional activities, but there are also numerous original articles, and an intensive system of review paragraphs. The main contribution in the section on description and phylogeny is by Spencer Savage, and concerns a manuscript by the younger Linnæus dealing with certain genera now included in the Amaryllidaceæ. W. S. Flory and S. H. Yarnell contribute a comprehensive review of chromosome numbers in the Hemerocallideæ, Alstromeriales and Amaryllidales, whilst Friedrich Meyer describes a new daffodil mutation, *Narcissus schizocoronatus*. Many other accounts of particular crosses also appear.

The section on the physiology of reproduction contains papers on the effect of growth substances on *Hippeastrum*, *Hemerocallis* and *Alstromeria* by Dr. Hamilton P. Traub, the editor, who also writes on new methods of propagating *Hemerocallis*. The tender crown tips are severed and then cut longitudinally into halves or quarters, which are capable of rooting in a sandy medium. Mr. Wyndham Hayward, secretary to the Society, has also shown that the portion of rhizome remaining after the crown has been severed can be induced to form four or five shoots, which can later be propagated as separate plants. H. H. Hume and J. V. Watkins have a paper on propagation of *Zephyranthes* by various methods of cutting the root plate of the bulb.

Very numerous papers on amaryllid culture appear, and a small section on harvesting, storage and forcing is to be expanded to greater dimensions next year. No narrow national limits are interpreted into the Society's title, and one cannot but be grateful for its international scope and appeal.

[1] From the Editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A. Pp. 272. Oct. 1937.

Science News a Century Ago

Publication of Newton's "Principia"

AT a meeting of the Ashmolean Society, Oxford, on May 14, 1838, over which Dr. Buckland presided, Prof. S. P. Rigaud (1774–1839) the Savilian professor of astronomy, read a paper on the first edition of the "Principia" of Newton. After referring to Newton's early speculations on gravitation, Prof. Rigaud said that the statement in the "Commercium Epistolicum" that he communicated some of his principal propositions of the "Principia" to the Royal Society, in 1683, was certainly a year too early. The first notice of them was given at the latter end of June 1684, and a more specific specimen of the treatise was probably sent in February 1685. The commonly received opinion was that the Royal Society was at the expense of publishing the "Principia" but this was decidedly a mistake. A resolution to that effect was passed at a general meeting, but was not adopted by the council; and Halley was not only at the pains of superintending the publication of the work, which he had induced Newton to complete, but also undertook to do so at his own risk. The printing was commenced in the summer of 1686, but some delay took place, so that not more than eleven sheets appear to have been finished in February 1687. Halley then resumed his work, which he finally accomplished about the latter end of June 1687; and he must therefore, in this last effort, upon an average, have carried two sheets through the press in each week. This speed was not occasioned, as some have imagined, by any fear of Newton's receding from his engagement. The irritation which he felt in 1686 at Hooke's unfounded claims to a prior knowledge of the true nature and laws of gravitation, induced him to think of suppressing the third book of the "Principia"; but after that irritation had subsided, there is not the slightest indication, in his correspondence with Halley, of any backwardness on his part, in drawing up the work or supplying what was necessary to prepare it for the press.

Royal Premium of the Royal Geographical Society

ON May 14, 1838, Colonel Francis Rawdon Chesney (1789–1872) was presented with the Royal Premium of the Royal Geographical Society. In making the presentation, W. R. Hamilton, the president, said: "You have been the pioneer, to point the way, and to open the road into a large range of country, hitherto imperfectly known; you, and those under your command, have really navigated, for the first time in modern history, two of the most celebrated rivers of the ancient world—the Euphrates and the Tigris; you have added largely to our knowledge of Syria and Mesopotamia, Assyria and Susiana; you have carried a line of levels from Iskanderùm to Bír, and thence along the whole course of the Euphrates to the Persian Gulf; you have laid down the course of the Orontes, from its mouth to Jisr Hadía, and you have done more than enough to secure to yourself a place among the distinguished geographers of our time. These are the grounds upon which the Council of the Royal Geographical Society have judged it right to award to you the first Royal Premium, which the munificence of our illustrious patron, Queen Victoria, has placed at their disposal, for the reward and encouragement of geographical researches."

In acknowledging the honour conferred upon him, Col. Chesney said: "I cannot help feeling some regret, that the rules of the Society do not permit me to urge the claims of those which were greater than mine individually; for I, at least, cannot forget, that the almost unequalled labour of the transport across Syria was chiefly accomplished when I was confined with a brain fever, and that the leading discoveries in geography were made when I was not present." He then went on to refer to the part played in the work of the expedition by Major Escourt, Mr. W. F. Ainsworth, Lieutenant Cleaveland and others.

A Large Montgolfier Balloon

IN the *Athenæum* of May 19, 1838, was the announcement of a proposed "Ascent of the Great Montgolfier Balloon from the Royal Zoological Gardens, Surrey, under the Immediate Patronage of Her Majesty". "On Thursday next, May 24," said the notice, "one of the most extraordinary novelties ever presented to the Public will take place: viz., the Ascent of several Aeronauts with a stupendous new Balloon on the original plan of Montgolfier, of inflation by rarified air instead of gas, being the first Aerial Voyage ever made in England with a Balloon on this principle. It is the largest Aerostatic machine ever fabricated in this country being more than half the height of the Monument, and of proportionate dimensions, and containing 170,000 Cubic Feet of Air. Its vast powers, and the peculiar method of inflation renders this first Ascent unparalleled in the history of Aerostation . . ."

University Events

CAMBRIDGE.—Dr. G. R. Owst has been elected to the newly created professorship of education that comes into operation on October 1. Dr. Owst came up to Emmanuel in 1913 and after an absence for war service took his degree in 1920. He taught in South Africa for the next two years and then returned to England and began to work under Prof. Claude Jenkins at King's College, London, on the subject of medieval preaching. This work and other studies arising from it, have been recognized by the award of D.Lit. London and the Litt.D. Cambridge. Since 1928 Dr. Owst has been an inspector of schools both elementary and secondary and is at the present moment staff inspector for history.

GLASGOW.—Dr. James Small, lecturer in the theory and practice of heat engines, has been elected to the James Watt chair of the theory and practice of heat engines, in succession to Prof. William J. Goudie.

Mr. C. R. Ribbands has been appointed assistant in zoology, in place of Mr. D. S. Bertram, who has joined the staff of the School of Tropical Medicine, as lecturer in entomology.

Mr. H. H. Brown has been awarded the degree of Ph.D. for a thesis entitled "A Study of a Tectibranch Gasteropod Mollusc *Philine aperta* (L.)".

OXFORD.—A. N. Black, Exeter College, has been appointed University demonstrator and lecturer in engineering for four years as from October 1.

The Frazer Lecture for 1938 will be given in the Examination Schools at 5 p.m. on May 23 by Dr. J. H. Hutton, William Wyse professor of social anthropology in the University of Cambridge. His subject will be "A Primitive Philosophy of Life".

Societies and Academies

London

Royal Society (*Proc. A.*, **165**, 313–452; April 14, 1938).

E. A. MILNE: On the equations of electromagnetism. (1) Identifications. (2) Field theory.

H. J. GOUCH and W. A. WOOD: Crystalline structure of steel at fracture.

EDMUND C. STONER: Collective electron ferromagnetism.

W. MANDELL: Resonance in crystal beams of sodium-ammonium seignette salt.

R. B. RANDALL, M. BENGER and C. M. GROOCOCK: Alkaline permanganate oxidation of organic substances selected for their bearing upon the chemical constitution of coal.

Paris

Academy of Sciences, March 14 (*C.R.*, **206**, 793–864).

GABRIEL BERTRAND and LAZARE SILBERSTEIN: The distribution of boron in the organs of the white lily. The amount of boron in the plant as a whole is small compared with other plants: it is lowest in the stem and highest in the reproductive organs.

PIERRE LEJAY and CHANG HUNG CHI: Gravimetric chart of the south of China.

ETIENNE HALPHEN: Research on the most independent chance variables.

ARYEH DVORETZKY: The geometrical basis of the theorem of M. Mandelbrojt and analogous theorems.

BÉLA DE SZ. NAGY: The extremal properties of Fourier series transformed by absolutely monotonic series.

KWOK-PING LEE: The Borel directions of meromorph functions of finite order higher than 1/2.

CARLOS BIGGERI: The singular points of a Taylor's series external to the circle of convergence.

GEORGES DEDEBANT, MICHEL KIVELIOVITCH and PHILIPPE WEHRLÉ: A method of establishing the equations of hydrodynamics.

LOUIS VIAUD: An experimental method for the study of an air blast in interaction with the soil.

M. and MME. LUCIEN D'AZAMBUJA: The velocity of rotation of solar prominences deduced from their successive passages on the central meridian of the star.

PAUL MULLER: A new double refracting prism and its application to the measurement of double stars.

V. FROLOW: The analysis of the maregraphic series of Norway.

RENÉ LUCAS: New properties of double refraction of liquids submitted to ultra-sounds. A column of liquid, placed between Nicol prisms set to extinction, shows reappearance of light when the liquid is submitted to ultra-sounds produced by piezo-electric quartz. These optical effects are very clear with some liquids (castor oil, linseed oil) but are inappreciable with others (glycerol, ethyl acetate).

GEORGES DECHÊNE: The capacity at the contact of a metal with a semi-conductor.

FRANTZ PERRIER: The determination of the wavelengths of the radiation emitted by electrified insulators: an attempt at a theoretical interpretation. From the measurement of the absorption coefficients in celluloid it is shown that the frequency of the radiation is proportional to the potential difference between the two faces of the dielectric.

MME. THÉRÈSE GRIVET-MEYER: Some properties of the penetrating fraction of the cosmic radiation. The properties of the hard variation vary with the thickness of the total screen interposed. It is not possible to represent the absorption of the radiation by a simple exponential.

LADISLAS GOLDSTEIN and ANATOLE ROGOZINSKI: The use of an ionization chamber with a liquid dielectric for the study of neutrons.

MARCUS BRUTZCUS: The thermochemistry of the sulphur compounds.

MLLE. YVONNE GARREAU: The constitution of some compounds formed by the oxidation of hydroquinone in the presence of ammonium sulphite or of primary amines.

TRYPHON KARANTASSIS and CONSTANTIN VASSILIADÈS: New oxyiodine compounds of the dialkyl derivatives of tin.

JEAN VÈNE: Syntheses starting from the bisulphite derivatives of the camphoric β-aldehyde esters.

HENRI LONGCHAMBON: Cordierite gneiss and granites in the French Central Massif.

GILBERT MATHIEU: The structure of the island of Yeu.

LOUIS EBLÉ and GASTON GIBAULT: The values of the magnetic elements at the Observatory of Chambon-la-Forêt (Loiret) on January 1, 1938.

GEORGES DUBOIS and MME. CAMILLE DUBOIS: The peats of Cragou (Finistère). Results of pollen analyses: the Cragou peat is relatively recent, neolithic.

GEORGES DEFLANDRE: Study of the organic materials forming certain fossil plankton microorganisms. Attempts at microchemical analysis. Results of the application of various staining reagents. The present ideas on the microchemistry of cellulose membranes, or of similar composition, based on the study of existing bodies or living beings, cannot be applied to plankton microfossils.

MLLE. MARIE CELAN: The structure of the central cells of *Halopitys pinastroides*.

ARTHUR BRUNEL: The degradation of substances of puric origin in the lamellibranch molluscs. *Mytilus edulis* possesses the property of degrading uric acid to urea and ammonia: allantoin and allantoic acid are the intermediate terms of this reaction.

MICHEL MACHEBŒUF and FRANCIS TAYEAU: The state of the lipids and of cholesterol in the blood serum: the destruction of certain lipidoproteinic cenapses and the liberation of their lipoid substances by a soap.

GUSTAVE GUITTONNEAU and RENÉ CHEVALIER: The attack of the benzene nuclei and the utilization for food of phenol by the *Azotobacter* of the soil. A strain of *Azotobacter* has been cultivated which grows on silicogel containing phenol, and which also grows on media containing mannitol, sodium benzoate, sodium *p*-oxybenzoate, but does not develop in the presence of *m*-oxybenzoate or *o*-oxybenzoate. This would appear to be a new physiological type of *Azotobacter*.

Moscow

Academy of Sciences (*C.R.*, **18**, No. 2, 1938).

S. SOBOLEV: A class of integro-differential equations with several independent variables. (2).

K. PERSIDSKIJ: The law of large numbers.

K. BRODOVITSKIJ: Statistical analysis of the rhythm of fundamentally unobservable regularities, observed manifestations of which are subject to some unknown perturbations.

I. M. GOLDMAN: Breakdown of compressed nitrogen in small gaps.

E. GROSS: The splitting-up of the Rayleigh line and the acoustic spectrum of crystals.

P. PETRENKO-KIRITSCHENKO: The law of periodicity.

M. V. GORLENKO: Resistance of winter wheats to black bacteriosis (*Bacterium translucens* var. *undulosum* S.J.R.).

A. A. ISAKOVA and A. A. ANDREJEV: The excretion of nitrogenous compounds by the roots of leguminous plants (lupin) and the conversion of these compounds in the presence of bacteria.

M. ABAKUMOVA: Problem of photo-periodical and temperature after-effects.

V. G. ALEKSANDROV and O. G. ALEKSANDROVA: The flintiness and flouriness of wheat endosperm.

N. G. CHLOPIN: Attempt at an experimental analysis of the auxiliary components of the nervous system.

J. A. VINNIKOV: Growth and transformation *in vitro* of myoneural elements (sphincter and dilator of the iris).

V. P. MICHAILOV: Growth and transformation *in vitro* of the covering cells of the vascular plexuses of the brain.

N. N. KANNEGISSER: Growth and transformation *in vitro* of the elements of the pia mater.

G. A. SCHMIDT: Ectoderm of the Anuran gastrula under the inductive influence of dead organizers and parts of organs of Amphibia and mammals.

Tokyo

Imperial Academy (*Proc.*, **14**, No. 2, 27–85, Feb. 1938).

S. KAKUTANI: The uniqueness of Haar's measure.

SHIN-ICHI IZUMI and TATSUO KAWATA: Notes on Fourier series. (3) Absolute summability.

HITOSHI HOMBU: The projective theory of 'paths' of the third order

$$x^{(3)i} + H^i(x, x^{(1)}, x^{(2)}) = 0.$$

KENZO JOH: A theorem of K. Löuner on univalent functions.

MASAO SUGAWARA: Siegel's modular function of the higher degree.

HANTARO NAGAOKA and TADAO MISHIMA: High terms of Paschen series in hydrogen and deuterium.

KEN SUGAWARA: Decompositions in shallower waters of a lake in summer and the supply of oxygen from the atmosphere.

MASAO KUBOKAWA: Activated adsorption of methane on reduced nickel.

SHIGEHIKO SUGASAWA, KÜCHIRO KAKEMI and TÔRU TSUDA: Synthesis of 6,7-dimethoxyquinoline.

HIDEKICHI YANAGISAWA and EÜCHI YOKOI: Purification of hirudin, an active principle of *Hirudo medicinalis*.

TEÜCHI KOBAYASHI and HISASHI MOCHIZUKI: Outline of the structure of the Kibi plateau on the inner side of western Japan.

SABURÔ ÔISHI: The Japanese equivalents of the *Lepidopteris* and *Thaumatopteris* zones of East Greenland.

GIHEI YAKAMA: (1) Hydrogen ion concentration, etc., of the anther sap of *Lilium* species. (2) Potential measurements of the dividing pollen mother cells of *Lilium speciosum*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 16

KING'S COLLEGE, LONDON, W.C.2, at 5.30.—Prof. Th. J. Stomps: "Recent Developments of the Mutation Theory".*

Wednesday, May 18

ROYAL SOCIETY OF ARTS, at 8.30.—Prof. K. W. Braid: "Bracken and its Present Menace to Heather and Pasture".

Thursday, May 19

ROYAL SOCIETY, at 2.30.—Discussion on Turbulence in Fluid Motions, to be opened by Prof. G. I. Taylor, F.R.S.

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, W.1), at 5.—Prof. W. V. D. Hodge: "Harmonic Integrals".

BRITISH INSTITUTE OF RADIOLOGY, at 6.30.—Annual General Meeting.

SIR JOHN CASS TECHNICAL INSTITUTE, ALDGATE, LONDON, E.C., at 7.—A. J. Murphy: "The Selection of Non-Ferrous Materials for Engineering Purposes" (succeeding lectures on May 26 and June 2).*

CHEMICAL SOCIETY, at 8.—Discussion on "Organic Intermolecular Complexes". Opened by Prof. G. M. Bennett.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT ENGINEER and CIVIL ENGINEERING ASSISTANTS in the Roads Department of the Ministry of Transport—Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (May 16).

LECTURER IN MATHEMATICS (woman) in Darlington Training College—Principal (May 18).

SENIOR SCIENTIFIC OFFICER in the Directorate of Civil Research and Production, Air Ministry—Permanent Under-Secretary of State, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2 (May 20).

SCIENTIFIC OFFICER, JUNIOR SCIENTIFIC OFFICER, TECHNICAL OFFICERS and ASSISTANTS (II) for work on wireless apparatus, etc., at the Signals Experimental Establishment, Woolwich, S.E. 18—Superintendent (May 20).

LECTURER IN PHYSIOLOGY in the University of Queensland—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (May 20).

ASSISTANT LECTURER IN CHEMICAL PATHOLOGY in the University of Manchester—Registrar (May 21).

SENIOR SCIENTIFIC OFFICER in the Admiralty scientific pool (physics, particularly acoustics)—Secretary to the Admiralty (C.E. Branch) quoting Ref. No. C.E. 3326/38 (May 21).

LECTURERS IN MATHEMATICS, PHYSICS, CHEMISTRY, AND CI. L AND MECHANICAL ENGINEERING DEPARTMENT of Woolwich Polytechnic, S.E.18—Secretary (send stamped addressed envelope) (May 21).

TWO ASSISTANTS (one with knowledge of aeronautics) in the CIVIL AND MECHANICAL ENGINEERING DEPARTMENT, a LECTURER IN CHEMISTRY and a LECTURER IN MATHEMATICS in the Northampton Polytechnic, St. John Street, London, E.C.1—Secretary (May 23).

LECTURER IN ZOOLOGY in King's College, Newcastle-upon-Tyne—The Acting Secretary to the Council (May 25).

PATHOLOGIST AND BACTERIOLOGIST at the Memorial Ophthalmic Laboratory, Cairo—Horace H. Rew, Examination Hall, Queen Square, London, W.C.1 (May 28).

HEAD OF THE DEPARTMENT OF PHYSICS at the Chelsea Polytechnic, London, S.W.3—Principal (May 28).

CHEMISTS in the War Department—Under-Secretary of State (C.5), War Office, S.W.1, quoting Appts./83 (May 28).

LECTURER IN MATHEMATICS and LECTURER IN CHEMISTRY in the Derby Technical College—Clerk to the Governors (May 28).

ASSISTANT METEOROLOGIST in the Meteorological Service of the Sudan Government—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, London, S.W.1 (May 31).

BACTERIOLOGIST in the Veterinary Department in Kenya—Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1 (May 31).

DEMONSTRATOR IN THE DEPARTMENT OF ZOOLOGY at Bedford College for Women, Regent's Park, N.W.1—Secretary (May 31).

LECTURER IN THE SCHOOL OF AGRICULTURE near Khartoum—University Appointments Board or Controller, Sudan Government (London Office), Wellington House, Buckingham Gate, S.W.1, marking envelope "Lecturer" (May 31).

ASSISTANT METEOROLOGIST in the British West African Meteorological Service—Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1 (May 31).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Manchester Municipal College of Technology—Registrar (June 1).

LECTURER IN BIOLOGY in the School of Science, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1 (June 1).

PRINCIPAL of the Marine School, South Shields—The Secretary (June 1).

ASSISTANT IN THE DEPARTMENT OF ARCHÆOLOGY in the Leicester Museum and Art Gallery—The Director (June 11).

DEMONSTRATOR IN ANATOMY in the University of Sheffield—Registrar (June 15).

LECTURER IN ZOOLOGY (marine zoology or physiology) in the University of Sydney—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (July 12).

JUNIOR RESEARCH INVESTIGATORS in the British Non-Ferrous Metals Research Association—Secretary, B.N.F.M.R.A., 1–6, Regnart Buildings, Euston Street, London, N.W.1.

INSTRUCTOR IN RADIO ENGINEERING for the Education Department, Straits Settlements—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/5561.

LECTURER IN CHEMISTRY with qualifications in physical chemistry in the University of Reading—Registrar.

LECTURER IN ELECTRICAL ENGINEERING in the University of Birmingham—Secretary.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 6, 1937. Pp. iv+183+6 plates. (London: Brompton Hospital.) 2s. 6d. [233

Imperial Bureau of Soil Science. Technical Communication No. 36 (Imperial Bureau of Pastures and Forage Crops, Herbage Publication Series, Bulletin 25): Erosion and Soil Conservation. By G. V. Jacks and R. O. Whyte. Pp. 206. (Harpenden: Imperial Bureau of Soil Science; Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) 5s. [84

Annals of the Cape Observatory. Vol. 14, Part 2: Observations of Major Planets made with the Heliometer at the Royal Observatory, Cape of Good Hope, during the Years 1932 to 1934. Pp. v+38. (London: H.M. Stationery Office.) 4s. net. [114

Observations made at the Royal Observatory, Greenwich, in the Year 1935 in Astronomy, Magnetism and Meteorology. Pp. viii+74+23+(lx+102)+65+46+28+9 plates. (London: H.M. Stationery Office.) [114

Proper Motions of Stars in the Zone Catalogue of 20,843 Stars, 1900 Zones −40° to −52° derived from Photographs taken at the Royal Observatory, Cape of Good Hope. Pp. xc+210. (London: H.M. Stationery Office.) 25s. net. [114

Imperial Bureau of Soil Science. Technical Communication No. 35: The Design and Analysis of Factorial Experiments. By F. Yates. Pp. 96. (Harpenden: Imperial Bureau of Soil Science.) 5s. [254

The Future of Civilisation and Social Science: a Study involving the Principles of Scientific Meliorism. By W. P. Dreaper. (Social Science Series, Vol. 1.) Pp. 48. (London: E. T. Heron and Co., Ltd.) 1s. [254

Reports of the Council and Auditors of the Zoological Society of London for the Year 1937. Pp. 89+2 plates. (London: Zoological Society.) [254

International Committee for Bird Preservation, British Section. Annual Report for 1937. Pp. 28. (London: International Committee for Bird Preservation.) [254

Air Ministry: Aeronautical Research Committee. Report for the Year 1937. Pp. 42. 2s. net. Reports and Memoranda. No. 1793: Visibility of Light Signals with special reference to Aviation Lights: Review of Existing Knowledge. Prepared by Dr. W. S. Stiles, assisted by M. G. Bennett and H. N. Green. Pp. 68. 9s. net. No. 1796 (2871): Some Aerodynamic Characteristics of Tapered Wings fitted with Flaps of Various Spans. By H. B. Irving, A. S. Batson, J. H. Warnap and H. J. Gummer. Pp. 43. 6s. net. No. 1797 (2668 and 2961): Wind Tunnel Tests on the Effect of Extreme Slipstream on Single and Twin-Engined Monoplanes with Split or Slotted Flaps. By Dr. J. H. Lees, H. Davies and C. Callen. Pp. 24. 3s. 6d. net. No. 1801 (3021): Nomenclature for Stability Coefficients. Proposed by L. W. Bryant and S. B. Gates. Pp. 8. 1s. 3d. net. No. 1802 (2708): A Rough Estimate of the Twist of Autogiro Blades in Flight. By D. M. Hirst. Pp. 8. 1s. 3d. net. No. 1804 (3020): The Profile Drag of Aerofoils at High Reynolds Numbers in the Compressed Air Tunnel. By Dr. R. Jones and D. H. Williams. Pp. 15. 2s. 6d. net. No. 1805 (2506): Full Scale Water Resistance of the Singapore IIC in Steady Motion. By J. Hanson. Pp. 11. 2s. net. No. 1806 (2427): Further Measurements of the Full Scale Water Resistance of a IIIF Seaplane in Steady Motion. By J. Hanson. Pp. 11. 2s. net. No. 1809 (3234): Torsional Oscillation of a Cantilever when the Stiffness is of Composite Origin. By Dr. W. J. Duncan and H. M. Lyon. Pp. 13. 2s. net. No. 1810 (3090): Analysis of Routine Tests of Monoplanes in the Royal Aircraft Establishment Free Spinning Tunnel. By E. Finn. Pp. 12. 2s. net. (London: H.M. Stationery Office.) [264

Ministry of Labour. Report for the Year 1937. (Cmd. 5717.) Pp. iv+136. (London: H.M. Stationery Office.) 2s. net. [264

Other Countries

Hamburger Sternwarte in Bergedorf. Bergedorfer Spektral-Durchmusterung der 115 nördlichen Kapteynschen Eichfelder: enthaltend für die Sterne bis zur 13 photographischen Grösse die Spektren nach Aufnahmen mit dem Lippert-Astrographen der Hamburger Sternwarte in Bergedorf, von A. Schwassmann; Die Grössen nach Aufnahmen des Harvard College Observatory bestimmt durch das Sternenkundig Laboratorium Kapteyn in Groningen, von P. J. van Rhijn. Band 2: Eichfeld 20 bis 43, Deklination +45°. Pp. 140+384. (Bergedorf: Verlag der Sternwarte.) [76

American Geographical Society. Special Publication No. 21: Rainfall and Tree Growth in the Great Basin. By Ernst Antevs. Pp. v+97+2 plates. (New York: American Geographical Society.) [76

Conseil Permanent International pour l'Exploration de la Mer. Tables for Calculating the Specific Volume of Seawater under Pressure. By Donald J. Matthews. Pp v+67. (Copenhague: Andr. Fred. Høst et fils.) [114

Lectures and Conferences on Mathematical Statistics. Delivered by J. Neyman. Revised and Supplemented by the Author with the editorial assistance of W. Edwards Deming. Pp. ix+160. (Washington, D.C.: Graduate School of the U.S. Dept. of Agriculture.) 1.25 dollars. [196

Bernice P. Bishop Museum. Bulletin 146: Ethnology of Tokelau Islands. By Gordon Macgregor. Pp. iii+183+10 plates. Bulletin 148: Tuamotuan Legends (Island of Anaa). Part 1: The Demigods. Translated by J. F. Stimson. Pp. 147. Bulletin 150: Ethnology of Pukapuka. By Ernest and Pearl Beaglehole. Pp. v+419+6 plates. Bulletin 151: Cryptorhynchinæ of Rapa. By Elwood C. Zimmerman. Pp. ii+75+4 plates. (Honolulu: Bernice P. Bishop Museum.) [254

Fossil Anthropoids of the Yale-Cambridge India Expedition. By William K. Gregory, Milo Hellman and G. Edward Lewis. (Carnegie Institution of Washington, Publication No. 495). Pp. iii+27+8 plates. (Washington, D.C.: Carnegie Institution.) [254

Canada. Department of Mines, Bureau of Economic Geology: Geological Survey. Memoir 194: Eagle-McDame Area, Cassiar District, British Columbia. (No. 2418.) By G. Hanson and D. A. McNaughton. Pp. ii+16+1 plate. 10 cents. Memoir 197: Little Southwest Miramichi-Sevogle Rivers Area, New Brunswick. (No. 2421.) By E. W. Shaw. Pp. ii+13+2 plates. 10 cents. Memoir 198: Geology of Woodstock Area, Carleton and York Counties, New Brunswick. (No. 2422.) By J. F. Caley. Pp. ii+21+2 plates. 10 cents. Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography: Geological Survey. Memoir 209: Mining Industry of Yukon, 1936. (No. 2438.) By H. S. Bostock. Pp. iii+11+1 plate. 10 cents. Memoir 212: Mineral Resources, Usk to Cedarvale, Terrace Area, Coast District, British Columbia. (No. 2442.) By E. D. Kindle. Pp. ii+63+1 plate. 25 cents. National Museum of Canada. Bulletin No. 87 (Anthropological Series No. 22): Physical Anthropology of the Roebuck Iroquois, with comparative Data from other Indian Tribes. By Sir Francis H. S. Knowles. Pp. viii+75. 25 cents. Bulletin No. 88 (Biological Series, No. 23): Botanical Investigations in Batchawana Bay Region, Lake Superior. By R. C. Hosie. With a Catalogue of the Vascular Plants, by T. M. C. Taylor, and A Study of the Mammal Population, by C. H. D. Clarke. Pp. v+152. 50 cents. Bulletin No. 89: Annual Report of the National Museum for the Fiscal Year 1936–37. Pp. 28. 25 cents. (Ottawa: King's Printer.) [254

Asociación Química Argentina. 25 Aniversario (1912–1937). Actos Celebrados. Pp. 35+4 plates. Fundación; Obra Realizada. Pp. 56+4 plates. (Buenos Aires: Asociación Química Argentina.) [264

Cornell University: Agricultural Experiment Station. Memoir 210: Aquatic Diptera. Part 4: Chironomidæ; Subfamily Chironominæ, by O. H. Johannsen; Part 5: Ceratopogonidæ, by Lillian C. Thomsen. Pp. 80+18 plates. Memoir 211: Studies of the Blood Precursor of Milk Fat. By L. A. Maynard, C. M. McCay, G. H. Ellis, A. Z. Hodson and G. K. Davis. Pp. 16. Bulletin 684: Economic Studies of Poultry Farming in New York. 1: Commercial Poultry Farms, 1926, 1929, 1930, 1931, 1932, 1933. By E. G. Misner and A. T. M. Lee. Pp. 118. Bulletin 685: An Economic Study of Land Utilization in Cortland County, New York. By E. H. Matzen. Pp. 56. (Ithaca, N. Y.: Cornell University.) [264

Catalogues, etc.

Zeitschriftenreihen und Sammelwerke aus dem Gesamtgebiet der Medizin, nebst Anhang Hand- und Lehrbücher Monographiensammlungen Handapparate. (Antiquariatskatalog Nr. 720.) Pp. 114. (Leipzig: Gustav Fock, G.m.b.H.).

Classified List of Second-Hand Scientific Instruments. (No. 113.) Pp. vi+58. (London: Charles Baker.)

Rare Books, also Illuminated Manuscripts, Books of Engravings, Notable Bindings, Early Printed, Old Bibles, Economics, Medical and Books and Autographs from the Library of Sir J. M. Barrie. (No. 624.) Pp. 77. (London: Francis Edwards, Ltd.)

A Catalogue of Botanical Books, many with Fine Coloured Plates. (No. 548.) Pp. 96. (London: Bernard Quaritch, Ltd.)

Rare and Valuable Books, 1472–1934. (Catalogue No. 627.) Pp. 57+7 plates. (London: Francis Edwards, Ltd.)

Musik: Praktisch, Historisch, Theoretisch. Teil 2: Fétis–Macarty. (Antiquariats-Katalog Nr. 52.) Pp. 113–224. (Leipzig: Karl Max Poppe.)

Mineralogie, Petrographie, Lagerstättenkunde: Enthält Zeitschriften, Bücher und Monographien zum Teil aus den Bibliotheken der Herren Prof. K. Busz, Hofrat C. Doelter, Prof. A. Sauer und des emeritierten Herrn Prof. R. Reinisch. (Antiquariatskatalog Nr. 721.) Pp. 92. (Leipzig: Gustav Fock, G.m.b.H.)